



March 2014

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

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GAO Highlights

Highlights of [GAO-14-340SP](#), a report to congressional committees

Why GAO Did This Study

This is GAO's annual assessment of DOD weapon system acquisitions, an area that is on GAO's High-Risk List. DOD and Congress have taken meaningful steps to improve the acquisition of major weapon systems, yet many programs are still falling short of cost and schedule estimates. Moreover, GAO has emphasized the importance of completing developmental testing before programs enter production and pointed out risks associated with such concurrent testing and production. With expected budgetary pressures, DOD cannot afford to miss opportunities to address inefficiencies in these programs to free up resources for higher priority needs.

This report responds to a mandate in the joint explanatory statement to the DOD Appropriations Act, 2009. It includes observations on (1) the cost and schedule performance of DOD's 2013 portfolio of 80 major defense acquisition programs; (2) the knowledge attained at key junctures in the acquisition process for 38 programs that were in development or early production; and (3) key acquisition reform initiatives and program concurrency. To develop the observations in this report, GAO analyzed cost, schedule, and quantity data from DOD's Selected Acquisition Reports. GAO also collected data from program offices on technology, design, and manufacturing knowledge; the use of knowledge-based acquisition practices; and the implementation of acquisition reforms and initiatives.

In commenting on a draft of this report, DOD cited its commitment to acquisition excellence and its positive effect on programs.

View [GAO-14-340SP](#). For more information, contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

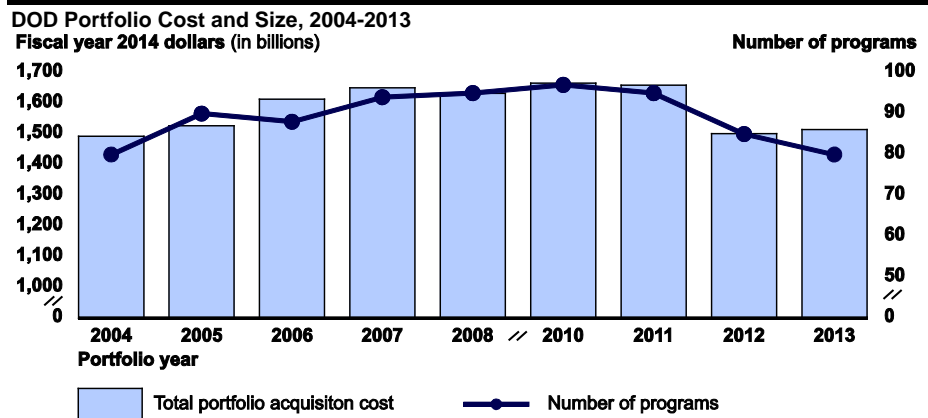
March 2014

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

What GAO Found

Over the past year, the overall size of DOD's major defense acquisition program portfolio decreased, from 85 programs to 80, while the estimated cost has increased by \$14.1 billion. The average time to deliver initial capability to the warfighter also increased by 2 months. The slight cost increase can be attributed to the addition of one program, the Evolved Expendable Launch Vehicle. This furthers a trend for decreased portfolio size seen for the past three years. Although the overall cost of the 2013 portfolio increased, 50 of the 80 programs decreased costs, and 64 percent of programs increased their buying power. There are still some programs that have performed poorly, both over the past year and in the longer term. Fifty-five percent of the current portfolio funding has been appropriated, leaving approximately \$682 billion needed for future funding. About forty-five percent of this remaining funding represents cost growth from initial estimates, a clear indicator that DOD needs to do more to control cost growth.



Source: GAO analysis of DOD data.

Note: The 2009 portfolio is excluded as the appropriate data was not available for review.

Most of the 38 programs GAO assessed this year are not yet fully following a knowledge-based acquisition approach. This held true for the seven programs that passed through one of three key decision points in the past year. Each implemented some knowledge based practices but practices—such as fully maturing technologies prior to development start and bringing all manufacturing processes under control—were not implemented. As a result, many of the 38 programs will carry unwanted risk into subsequent phases of acquisition that could result in cost growth or schedule delays.

Implementation of the reform initiatives on the 38 programs assessed above, and 18 that are not yet major defense acquisition programs, GAO analyzed varies. Specifically, while the department has been successful in implementing its "should cost" initiative to reduce contract costs and established configuration steering boards, the establishment of limits on total program costs (i.e. affordability constraints) and the need for greater competition are not being implemented to the same degree. In addition, many programs continue to commit to production before completing developmental testing.

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Abbreviations

AEHF	Advanced Extremely High Frequency
AMDR	Air and Missile Defense Radar
BMDS	Ballistic Missile Defense System
CSB	configuration steering board
DAMIR	Defense Acquisition Management Information Retrieval
DDG 51	DDG 51 Arleigh Burke Class Guided Missile Destroyer
DOD	Department of Defense
eSRS	Electronic Subcontracting Reporting System
G/ATOR	Ground/Air Task Oriented Radar
GCV	Ground Combat Vehicle
JLTV	Joint Light Tactical Vehicle
LCS	Littoral Combat Ship
MRL	manufacturing readiness level
NA	not applicable
OMB	Office of Management and Budget
PIM	Paladin Integrated Management
SAR	Selected Acquisition Report
SIBRS	Space Based Infrared System
TBD	to be determined
TRL	technology readiness level
WIN-T Inc 3	Warfighter Integration Network-Tactical Increment 3
WSARA	Weapon Systems Acquisition Reform Act

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441 G St. N.W.
Washington, D.C. 20548

March 31, 2014

Congressional Committees

I am pleased to present GAO's 12th annual assessment of the Department of Defense's (DOD) major defense acquisition programs. This report offers observations on the performance of DOD's current \$1.5 trillion portfolio of 80 programs. At its current size, this portfolio will require almost one-third of all expected development and procurement funding during the next 5 years. With the decline in the availability of discretionary funding, DOD cannot afford to miss opportunities to address inefficiencies in these programs to free up resources for additional high priority needs such as support of current operations. Consistent with our past recommendations, Congress and DOD have taken meaningful steps over the past several years to address long-standing problems with DOD weapon system acquisitions—an area that has been on GAO's high-risk list for more than 20 years.¹ We are encouraged about these steps, but we are also mindful that previous attempts to implement best practices and reign in cost and schedule overruns have failed or resulted in only marginal improvements.

Our current assessment shows that the estimated cost of DOD's 2013 portfolio of major defense acquisition programs is \$14.1 billion more than the 2012 portfolio while the size of the portfolio decreased from 85 to 80 programs.² This places the size and cost of the portfolio on par with what it was for the 2004 portfolio, as opposed to the peak in size and cost seen in the \$1.7 trillion, 97-program portfolio in 2010. Over the past year, the 80 programs of the 2013 portfolio have grown by a total of \$12.6 billion, a net cost increase nearly all attributable to the significant procurement cost associated with one program—the Evolved Expendable Launch Vehicle. The cost growth of the portfolio as a whole is not necessarily indicative of the performance of every program as 50 of the 80 programs reduced their

¹GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: February 2013).

²Our assessment of DOD's 2012 portfolio of 86 major defense acquisition programs included the Missile Defense Agency's Ballistic Missile Defense System (BMDS). While DOD continues to report on BMDS as a major defense acquisition program, we exclude it from our assessment this year as the program lacks an acquisition program baseline comparable to the other programs, preventing us from measuring cost and schedule change in a manner consistent with our methodology. For more information on cost and schedule baselines for BMDS and the challenges for oversight they present see GAO, *Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*, [GAO-13-432](#) (Washington, D.C.: Apr. 26, 2013).

costs over the past year. While a large number of programs did reduce cost over the past year, the need for continued oversight and cost management remains as many programs are still not achieving the long-range targets for limited total acquisition cost growth discussed by GAO, DOD, and the Office of Management and Budget. Our assessment also shows that the implementation of knowledge-based acquisition practices varied across the portfolio, though programs that entered over the past 5 years were more likely to follow knowledge-based principles at development start thereby making them more likely to achieve their cost, schedule, and performance objectives. Finally, our analysis shows that many programs are implementing selected acquisition reforms focused on affordability and cost savings, although DOD continues to accept risks by allowing programs to begin production before completing developmental testing. This report also includes brief assessments of 56 future and current major defense programs that provide additional insights into the performance of the portfolio.

Current and anticipated fiscal constraints make it imperative that DOD continue to find ways to improve the efficiency of its major weapon systems portfolio while still delivering the capabilities required by the warfighter. While many of the recent efficiencies achieved by programs decreased their costs without reducing quantities, it is unclear how much more savings can be obtained in this manner or if the estimates of future saving based upon ongoing DOD efficiency initiatives will come to fruition. Continued strong leadership on the part of DOD is essential, whether on advancing gains made through “Better Buying Power” initiatives or in enforcing a broader implementation of best practices in all aspects of a new weapon system acquisition as it enters the portfolio.

A handwritten signature in black ink, reading "Gene L. Dodaro". The signature is fluid and cursive, with a large, stylized "D" and a long, sweeping underline.

Gene L. Dodaro
Comptroller General
of the United States



March 31, 2014

Congressional Committees

In response to the mandate in the joint explanatory statement to the Department of Defense Appropriations Act, 2009, this report provides perspectives on how well the department is planning and executing its \$1.5 trillion portfolio of major weapon programs, in addition, this report includes information related to small business participation pursuant to a mandate in a report accompanying the National Defense Authorization Act for Fiscal Year 2013.¹ The current portfolio's cost has declined since peaking at \$1.7 trillion in 2010 and is currently at its lowest point in almost 10 years. In addition, the number of programs in the portfolio has decreased from 97 in 2010 to 80 programs in 2013. Since the first issuance of this series of reports in 2003, Congress and DOD have made meaningful improvements to the statutory and policy frameworks that govern the defense acquisition system by mandating and encouraging a more knowledge-based approach for major weapon programs. However, we have noted in the past that practice has lagged behind policy in certain areas and commensurate improvements in program outcomes are often not evident as many programs continue to cost more and take longer to develop than originally estimated. The changes in DOD's portfolio over the past few years indicate that some improvements are being realized in the near term. With the prospect of decreased defense budgets in the near future, it is imperative that DOD continue to find ways to reduce cost and improve the economy and efficiency of its acquisition practices not only in the short term, but throughout the life of current and future defense acquisition programs. Such cost reductions may be found by changing program acquisition strategies to include a more knowledge-based approach through the implementation of acquisition reforms and initiatives and the reduction of practices like concurrent testing and production, the risks of which we have identified repeatedly.

This report includes observations on (1) the cost and schedule performance of DOD's 2013 portfolio of 80 major defense acquisition programs, (2) the knowledge attained at key junctures in the acquisition

¹See Explanatory Statement, 154 Cong. Rec. H 9427, 9526 (daily ed., Sept. 24, 2008), to the Department of Defense Appropriations Act, 2009, contained in Division C of the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009, Pub. L. No. 110-329 (2008) and H.R. Rep. No. 112-479, at 284 (2012), *accompanying* Pub. L. No. 112-239.

process for 38 weapon programs in development or early production, and (3) key acquisition reform initiatives and whether programs are conducting or planning concurrent testing and production.²

Our observations in this report are based on three sets of programs:

- We assessed 80 major defense acquisition programs in DOD's 2013 portfolio for our analysis of cost and schedule performance. We obtained cost, schedule, and quantity data from DOD's December 2012 Selected Acquisition Reports (SAR) and from the Defense Acquisition Management Information Retrieval Purview system.
- We assessed 38 major defense acquisition programs that were mostly between the start of development and the early stages of production for our analysis of knowledge attained at key junctures and the implementation of acquisition reforms. We obtained information on the extent to which the programs follow knowledge-based practices for technology maturity, design stability, and production maturity using a data-collection instrument. We also submitted a questionnaire to program offices to collect information on issues such as systems engineering reviews, design stability, manufacturing planning and execution, and the implementation of specific acquisition reforms. We received questionnaire responses from all 38 programs from August to November 2013.
- In addition, we assessed 18 future major defense acquisition programs in order to gain additional insights into knowledge attained before the start of development and the implementation of key acquisition reform initiatives. We submitted a questionnaire to program offices to collect information on issues such as program schedule events, costs, and numerous acquisition reforms, and received responses from all 18 programs from August to November 2013.

²Major defense acquisition programs (MDAP) are those identified by DOD with a dollar value for all increments estimated to require eventual total expenditure for research, development, test, and evaluation of more than \$480 million, or for procurement of more than \$2.79 billion, in fiscal year 2014 constant dollars. DOD has a list of programs designated as future major defense acquisition programs. These programs have not formally been designated as MDAPs; however, DOD plans for these programs to enter system development, or bypass development and begin production, at which point they will likely be designated as MDAPs. We refer to these programs as future major defense acquisition programs throughout this report.

In addition to our observations, we present individual assessments of 56 weapon programs. Selection factors include major defense acquisition programs in development or early production, future programs, and recently canceled or restructured programs.

We conducted this performance audit from June 2013 to March 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings based on our audit objectives. Appendix I contains detailed information on our scope and methodology.

Observations on the Cost and Schedule Performance of DOD's 2013 Major Defense Acquisition Program Portfolio

The estimated cost of DOD's 2013 portfolio of 80 weapon programs is \$14.1 billion more than the 2012 portfolio of 85 programs. The 80 programs within this year's portfolio have had estimated cost increases of \$12.6 billion against their estimates from a year ago and an average of 2 months increase in schedule. This increase masks otherwise positive trends as 50 of 80 programs in the portfolio decreased their total acquisition costs and the majority of the cost increases can be traced to either the effects of additional procurement quantities or inefficiencies experienced in a few programs. Though notable, the cost reductions achieved by the programs in the 2013 portfolio over the past year need to be weighed against the increases many of these programs have had over the past five years or since their first full estimate of costs. Our analysis of DOD's 2013 portfolio allows us to make the following eight observations.

Cost and Schedule Performance Observations

General changes in the portfolio

1. When compared to the 2012 portfolio, the size of DOD's 2013 portfolio decreased from 85 to 80 programs, but its overall cost has increased by \$14.1 billion from \$1,501 billion to \$1,515 billion. The decrease in portfolio size follows a trend from the past 3 years.^a
2. When comparing the cost and schedule estimates of the 80 programs in the 2013 portfolio we found cost growth of \$12.6 billion and an average schedule delay of 2 months over the past year. When assessed against first full estimates, the total cost of the 2013 portfolio has increased by nearly \$448 billion with an average delay of 28 months in operating capability.^b

Factors that explain the changes

3. While the overall cost of the 2013 portfolio has increased, 50 of the 80 programs within the portfolio reduced their costs over the past year. The majority of the net cost growth can be attributed to a single program, the Evolved Expendable Launch Vehicle (EELV).
4. Our analysis shows that, when the effects of quantity changes are accounted for, DOD improved buying power on 64 percent of the programs in the portfolio over the past year.
5. As measured against metrics discussed by GAO, the Office of Management and Budget, and DOD in 2008, only 55 percent of programs in the 2013 portfolio meet the metric for less than 10 percent growth over the past 5 years and only 44 percent meet the metric for less than 15 percent growth since first full estimates; both proportions are smaller than in the 2012 portfolio, which demonstrates that a program can experience an interval of cost stability between periodic cost increases.

Other observations

6. The total acquisition cost of the portfolio is driven in large part by the 10 costliest programs, which represent 59 percent of current portfolio's total cost. These 10 programs alone incurred a net cost increase over the past year of approximately \$15.4 billion due primarily to quantity increases on the EELV, while the other 70 programs reported a net cost decrease of \$2.8 billion over the same period.
7. The majority of the cost of the portfolio is concentrated in two system types and the amount and type of cost growth from first full estimate, as well as the schedule delay, varied significantly by system type.
8. DOD has already been appropriated more than \$833 billion for the current portfolio, leaving approximately \$682 billion in costs to be funded, mostly for procurement. Approximately 45 percent of the remaining cost represents growth from first full estimates. Almost two-thirds of the future funding is needed for 10 programs, with 35 percent of the total costs remaining required for the F-35 program alone.

^aAll dollar figures are in fiscal year 2014 constant dollars, unless otherwise noted.

^bTotal acquisition cost includes acquisition-related operation and maintenance costs and system-specific military construction costs in addition to development and procurement costs.

Additional details about each observation follow.

-
1. **When compared to the 2012 portfolio, the size of DOD’s 2013 portfolio decreased from 85 to 80 programs, but its overall cost has increased by \$14.1 billion, from \$1,501 billion to \$1,515 billion. The decrease in portfolio size follows a trend from the past 3 years.** With 80 programs and an estimated total cost of more than \$1.5 trillion, the 2013 portfolio has fewer programs but a larger total acquisition cost when compared to the 2012 portfolio. The changes from the 2012 portfolio to the 2013 portfolio are outlined in table 1 below.

Table 1: Changes in DOD’s Portfolio of Major Defense Acquisition Programs from 2012 to 2013

Fiscal year 2014 dollars in billions	
2012 portfolio (85 programs)	\$1,501.1
Less cost of 12 exiting programs	-\$73.1
Plus estimated total cost of 7 entering programs	+\$101.6
Less net cost changes of 73 remaining programs	-\$14.4
2013 portfolio (80 programs)	\$1,515.2

Source: GAO analysis of DOD data.

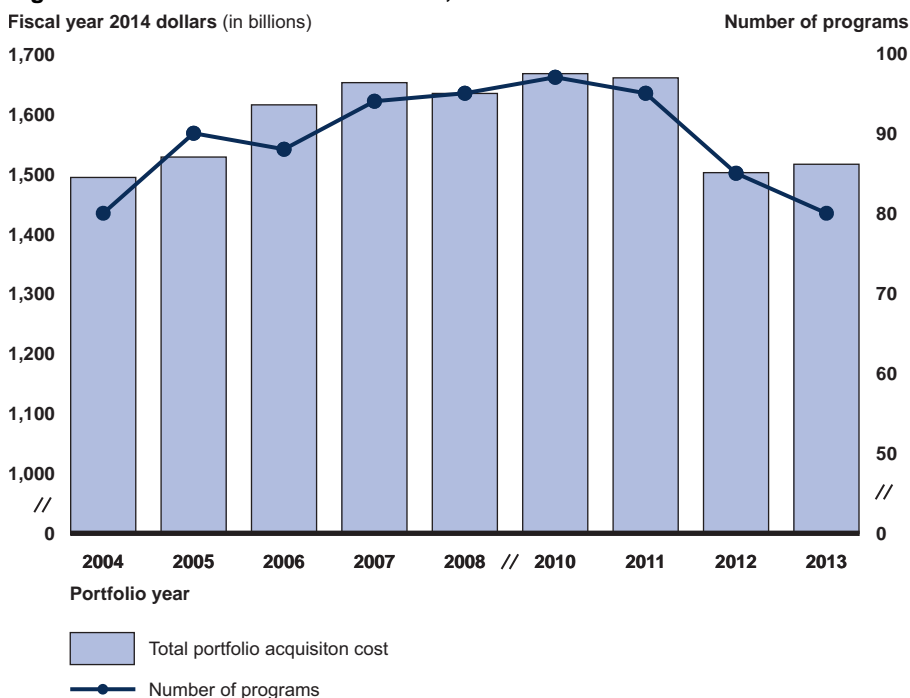
Note: Our assessment of DOD’s 2012 portfolio included the Ballistic Missile Defense System (BMDS). We exclude it from our assessment this year as the program lacks an acquisition program baseline comparable to other programs, preventing us from measuring cost and schedule change in a manner consistent with our methodology. To make the comparisons above we adjusted the 2012 portfolio estimates to reflect the removal of BMDS. Some numbers may not sum due to rounding.

The 2013 portfolio reflects a net reduction of 5 programs—from 85 to 80—and, when all the programmatic changes are taken into account, the cost of the 2013 portfolio is \$14.1 billion more than the 2012 portfolio.³ The current size of the portfolio in terms of number of

³The 12 programs that exited the portfolio were AIM-9X Block I, C-130 Avionics Modernization Program, Chemical Demilitarization-Chemical Materials Agency, Cobra Judy Replacement, High Mobility Artillery Rocket System, Joint High Speed Vessel, Joint Tactical Radio System Ground Mobile Radio, Multi-Platform-Radar Technology Insertion Program, National Polar-orbiting Operational Environmental Satellite System, Stryker Family of Vehicles, Thermal Weapons Sight, Warfighter Information Network - Tactical Increment 1. The seven that entered the portfolio were Airborne Warning and Control System Block 40/45 Upgrade, AN/TPS-80 Ground/Air Task Oriented Radar, B61 Mod 12 Life Extension Program Tailkit Assembly, Evolved Expendable Launch Vehicle, Joint Light Tactical Vehicle, Next Generation Operational Control System (GPS OCX), and Ship to Shore Connector.

programs and total cost is similar to that seen in the 2004 portfolio and furthers a trend for decreased portfolio size, and to some extent cost, seen since the 2010 portfolio. Figure 1 shows the cost and size of DOD's portfolios of major weapons acquisitions over the past 10 years.

Figure 1: DOD Portfolio Cost and Size, 2004-2013



Source: GAO analysis of DOD data.

Note: The 2009 portfolio is excluded because there were no annual SARs released for the December 2008 submission date.

A closer look at the 7 programs that entered the portfolio shows that 4 entered the portfolio at the beginning of system development. In contrast, two of the other three programs—the AN/TPS-80 Ground/Air Task Oriented Radar (G/ATOR) and the Airborne Warning and Control System Block 40/45 Upgrade—entered the portfolio long after their development start and are in production or will have a production decision in 2013. These programs were not originally planned as major acquisitions, but their costs grew past the threshold for major defense acquisition programs. For example, G/ATOR began system development in 2005 as a non-major defense acquisition program and

was reclassified due to program cost growth realized after completing 6 years of an 8-year development effort. The final program, EELV, re-entered the portfolio in response to statutory direction and soon after reported a quantity increase and a critical breach of Nunn-McCurdy unit cost threshold.⁴

Of the 12 programs that exited the portfolio, 8 completed development and fielded a system, while three were canceled after reporting substantial development cost growth or delays to their planned initial capability or, in one case, both. A final program, the Joint High Speed Vessel, exited the portfolio after a quantity reduction caused its cost to slip below the threshold for major defense acquisition programs.

- 2. When comparing the cost and schedule estimates of the 80 programs in the 2013 portfolio we found cost growth of \$12.6 billion and average schedule delay of 2 months over the past year.** While the above observation states the change from the 85 program 2012 portfolio due to programs exiting and entering, in this observation we measure the change that occurred only on the 80 programs in the 2013 portfolio. Table 2 shows the changes in cost and schedule for the 2013 portfolio in the past year.

⁴Section 2433 of title 10 of the United States Code, commonly referred to as Nunn-McCurdy, requires DOD to notify Congress whenever a major defense acquisition program's unit cost experiences cost growth that exceeds certain thresholds. This is commonly referred to as a Nunn-McCurdy breach. Significant breaches occur when the program acquisition unit cost or procurement unit cost increases by at least 15 percent over the current baseline estimate or at least 30 percent over the original estimate. For critical breaches, when these unit costs increase at least 25 percent over the current baseline estimate or at least 50 percent over the original, DOD is required to take additional steps, including conducting an in-depth review of the program. Programs with critical breaches must be terminated unless the Secretary of Defense certifies to certain facts related to the program and takes other actions, including restructuring the program. 10 U.S.C. § 2433a.

Table 2: Changes in DOD's 2013 Portfolio of 80 Major Defense Acquisition Programs over the Past Year

Fiscal year 2014 dollars in billions

	Estimated 2013 portfolio cost in 2012	Estimated 2013 portfolio cost in 2013	Increase since 2012	Percentage change since 2012
Total estimated research and development cost	\$286.7	\$288.7	\$2.0	0.7%
Total estimated procurement cost	1,201.6	1,213.2	11.5	1.0
Total other acquisition costs ^a	14.3	13.3	-0.9	-6.3
Total estimated acquisition cost	1,502.6	1,515.2	12.6	0.8
Average delay in delivering initial capabilities	—	—	2 months	2.8%

Source: GAO analysis of DOD data.

Note: Some numbers may not sum due to rounding.

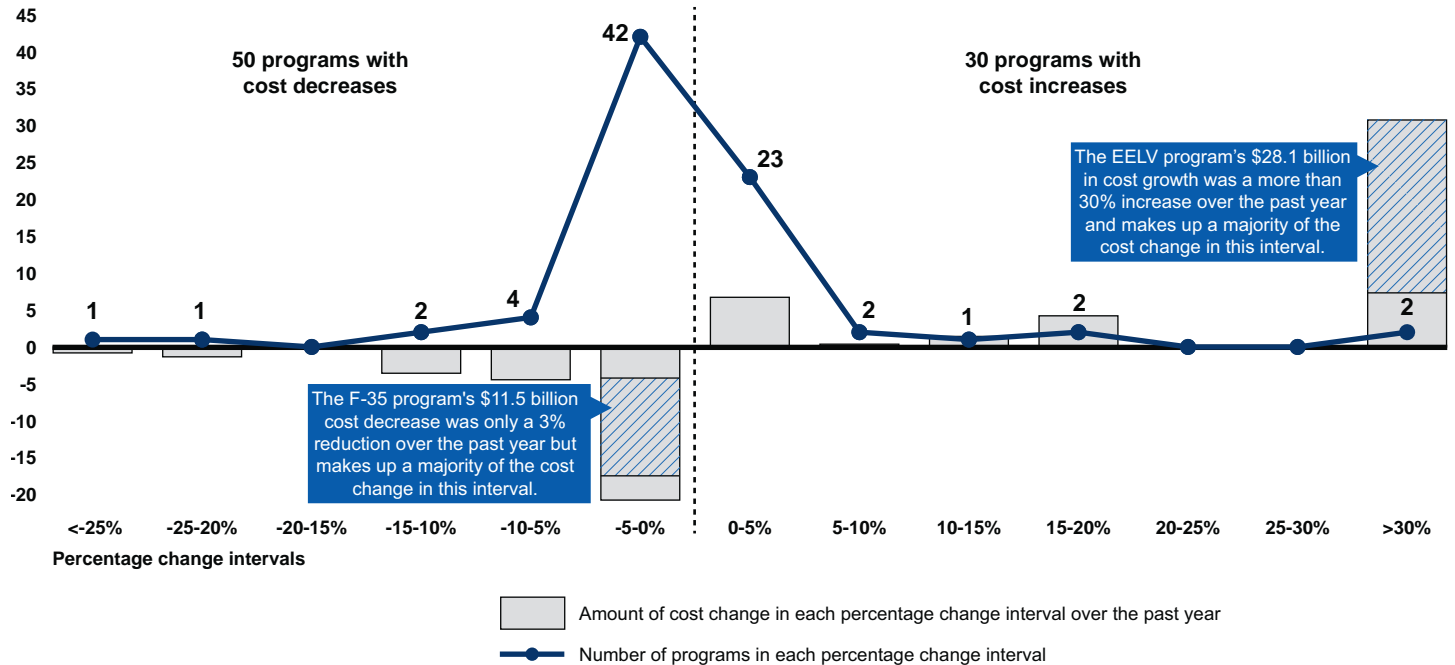
^aIn addition to research and development and procurement costs, total acquisition cost includes acquisition-related operation and maintenance and system-specific military construction costs.

The rise in total acquisition cost within the current portfolio over the past year is attributable to cost growth in both development and procurement, with procurement accounting for more than 90 percent of the total increase. Decreases in other costs, such as military construction, result in a net cost growth of \$12.6 billion for these 80 programs over the past year. When measured against programs' first full estimates, the total acquisition cost of the current portfolio has grown by \$447.8, or nearly 42 percent. The average delay in delivering initial capabilities has slipped an additional 2 months over the past year. The average delay against first full estimates is 28 months, on average.

3. **While the overall cost of the 2013 portfolio has increased, 50 of the 80 programs within the portfolio reduced their costs over the past year. The majority of the net cost growth can be attributed to a single program—EELV.** The \$12.6 billion increase shown in table 2 above is the net result of cost changes on all 80 programs in the current portfolio. The distribution of those cost changes across the portfolio is shown below in figure 2.

Figure 2: Distribution of the Total Acquisition Cost Change for the 2013 Portfolio

Fiscal year 2014 dollars (in billions)



Source: GAO analysis of DOD data.

Our analysis, as represented above, shows that 50 programs experienced cost decreases totaling almost \$30.9 billion during the past year while 30 programs reported cost increases totaling approximately \$43.5 billion. Of the programs that decreased their total acquisition costs,

- 38 did so by finding efficiencies within the program and not by decreasing procurement quantities;
- 9 reduced their procurement quantities thereby reducing overall cost; and
- 3 increased their procurement quantities but found enough offsetting efficiencies to reduce overall cost.

The most significant of these decreases is the \$11.5 billion reduction to the F-35 Joint Strike Fighter program's estimate, due solely to

efficiencies found within the program as no decrease in quantities was reported. In contrast, 30 programs reported cost increases. Of these,

- 17 reported cost increases due to inefficiencies in the program and not any change to procurement quantities;
- 12 programs increased their procurement quantities; and
- 1 program reduced estimated procurement quantities but still reported an increase to total costs.

The most significant of the programs with increases to total acquisition cost was EELV, which reported an increase in the number of launch services it expected to procure and a \$28.1 billion, or 78 percent, increase in total acquisition cost during the past year. As can be seen from the preceding tally of individual cost increases and decreases, to better understand the changes to cost the effect of changes to quantity must be understood.

4. **Our analysis shows that, when the effects of quantity changes are accounted for, DOD improved buying power on 64 percent of the programs in the portfolio over the past year.** Although procurement costs for the portfolio increased by \$11.5 billion over the past year, this growth is lower than GAO's calculations of the expected cost growth due to quantity changes, indicating that programs found efficiencies in other areas and increased their buying power.⁵ In general, buying power can be defined as the amount of good or service that can be purchased given a specified level of funding. Our calculation of how programs' cost and quantity changes affected their buying power are presented in table 3.

⁵A description of this calculation can be found in the detailed scope and methodology in appendix I.

Table 3: Increases in Buying Power for the 2013 Portfolio over the Past Year

Fiscal year 2014 dollars in billions

	Number of programs	Actual procurement cost change	GAO-calculated cost change attributable to quantity changes	GAO-calculated cost change not attributable to quantity changes
Increased buying power	51	-\$23.0	\$4.9	-\$27.9
Procurement cost decreased with no quantity change	35	-22.6	0	-22.6
Quantity increased with less cost increase than anticipated	10	4.8	7.9	-3.1
Quantity decreased with more cost decrease than anticipated	6	-5.2	-3.0	-2.2
Decreased buying power	25	\$34.5	\$22.4	\$12.1
Procurement cost increased with no quantity change	16	4.7	0	4.7
Quantity increased with more cost increase than anticipated	5	32.1	25.3	6.8
Quantity decreased with less cost decrease than anticipated	4	-2.3	-2.9	0.5
No change in buying power	4	\$0	\$0	\$0
Total	80	\$11.5	\$27.3	-\$15.8

Source: GAO analysis of DOD data.

Note: Some numbers may not sum due to rounding.

Based on our analysis, a total of 51 programs increased their buying power in the past year, resulting in a total of \$23 billion in procurement cost reductions. Thirty-five of the programs that decreased their procurement cost did so without reducing quantities, an indication that they found efficiencies elsewhere. Ten programs increased their expected procurement quantities but their total procurement cost increase was less than would be expected based upon the average procurement unit cost of each program used in GAO's calculation. For example, over the past year the DDG 51 program added two ships to its planned procurement, at an estimated unit cost of more than \$1.3 billion. If the resulting procurement cost increase from these additional quantities is ignored the cost for the program actually decreases, due to the fact that it found efficiencies elsewhere that increased the program's buying power even as the program increased quantities. An additional 6 programs decreased their quantities but achieved cost reductions in excess of that anticipated by GAO's cost calculations. For example, the Littoral Combat Ship (LCS) program reported a procurement cost decrease of over \$3 billion. While a significant portion of this reduction was achieved by removing three ships from the planned procurement, almost half, \$1.2 billion, was due to factors

other than the quantity reduction, such as a revised estimate that reflects lower future costs.

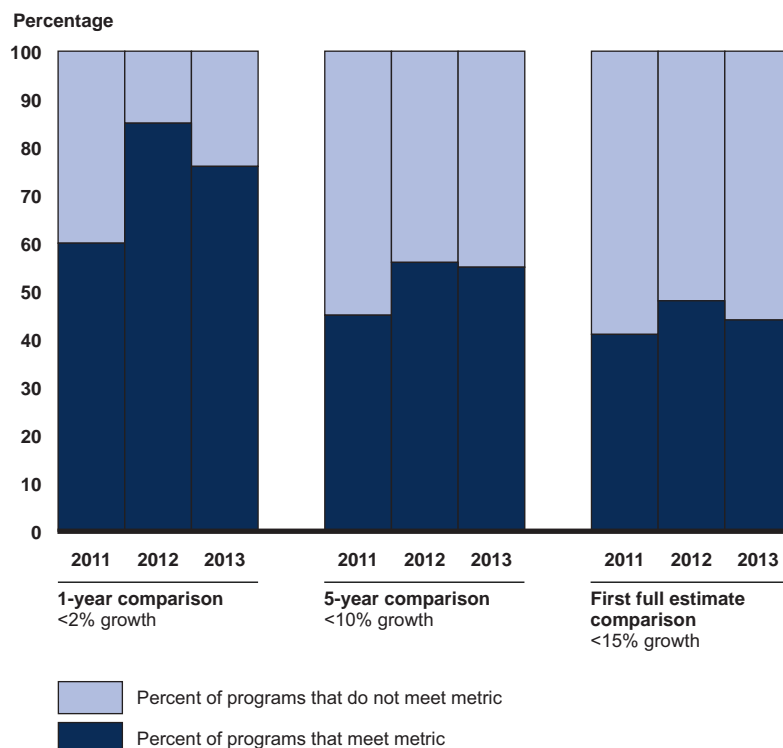
Increases in buying power such as these could be expected to continue as many of the programs that responded to our questionnaire indicated that they expected large amounts of “should-cost” savings in the future. The “should-cost” initiative, introduced through DOD’s “Better Buying Power” initiatives, emphasizes the importance of driving cost improvements during contract negotiation and program execution to control costs, improvements that could lead to program efficiencies which increase buying power. For example, the AIM-9X Block II Air-to-Air Missile program realized a procurement cost decrease of approximately \$327 million with no change in quantity over the past year and also reported \$128 million in “should-cost” savings that are expected in the future. In another case, the MQ-4C Triton Unmanned Aircraft System also realized decreasing procurement costs of \$274 million over the past year while maintaining the same quantity and reported that another \$480 million in “should-cost” savings are expected in the future.

Our analysis in table 3 above also shows that procurement costs for 25 programs increased by \$34.5 billion, but by our calculation only \$22.4 billion can be attributed to the cost of procuring additional units, with \$12.1 billion of that increase attributable to other factors. The most significant increase was that of the EELV program, which reported increasing its expected launches, the program’s measure of quantity, by 60 resulting in an estimated \$28 billion procurement cost increase, \$6 billion of which was not attributable to the quantity increase.

- 5. As measured against metrics discussed by GAO, the Office of Management and Budget (OMB), and DOD in 2008, only 55 percent of programs in the 2013 portfolio meet the metric for less than 10 percent cost growth over 5 years and 44 percent meet the metric for less than 15 percent growth since full first estimates; both proportions are smaller than in the 2012 portfolio, which demonstrates that a program can experience an interval of cost stability between periodic cost increases.** In December 2008, DOD, OMB, and GAO, discussed a set of outcome metrics and goals to measure program cost performance over time. The metrics are intended to measure total program cost-performance on a percentage basis over three time periods: the preceding year, the preceding 5 years, and the period since first full program estimates were

established. We have reported on these outcomes in past assessments. Seventy-six percent of the programs in the 2013 portfolio are meeting the one-year cost performance metric by limiting their total acquisition cost growth to less than 2 percent, consistent with the cost decreases and increases explained earlier. Fewer programs, however, are meeting the metrics for limited growth in the past five years and since first full estimates; 55 percent meet the 5-year metric while 44 percent are meeting the since first full estimate metric. This demonstrates that some programs with reduced or stable costs over the past year have previously had one or more cost increases. Programs do not generally experience cost change in a linear fashion with set amounts of increase or decrease every year, rather they have periods of more dramatic change interspersed with periods of stability. The performance of the 2013 portfolio, as well as the two previous weapon system portfolios, against these metrics is shown in figure 3.

Figure 3: Comparison of the Cost Performance of DOD's 2011, 2012, and 2013 Portfolios



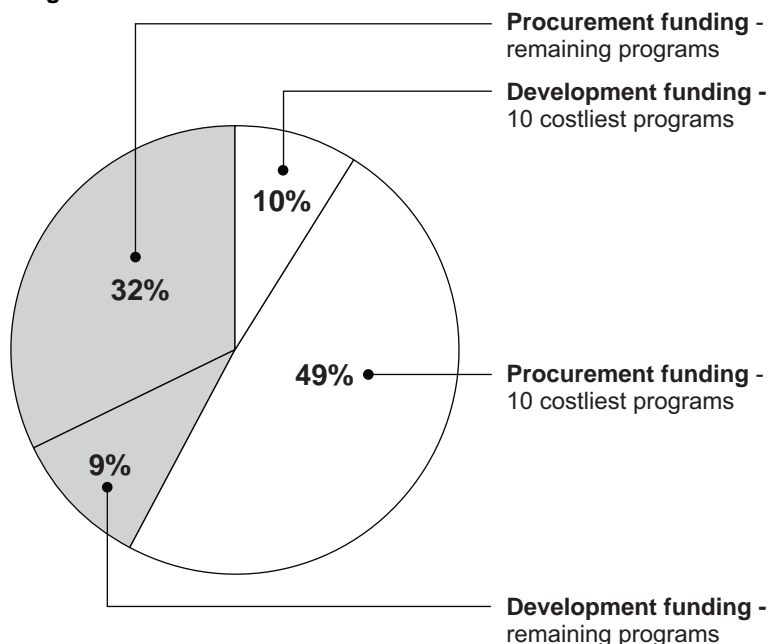
Source: GAO analysis of DOD data.

Note: Cost growth metric is defined as the percentage change in total program acquisition cost. Analysis includes the evaluation of cost growth on individual programs in the portfolio for each year. For programs where cost growth is measured on separate program sub-element, the elements were combined to calculate the cost growth on the entire program as a whole.

As a whole, aggregate cost performance of the 2013 portfolio has degraded across all three metrics from that observed in the 2012 portfolio. The percentage increase from 2012 to 2013 in programs that do not meet the cost metrics is attributable to two factors. First, many of the 12 programs that are no longer in the portfolio were meeting one or more of the three cost metrics while 2 of the 7 that entered—EELV and G/ATOR—do not meet one or more metrics. Second, performance against the cost metrics has grown worse on some of the ongoing programs. For example, the number of programs that do not meet the 1-year cost growth metric increased by 5—eight programs improved to meet this criterion in 2013 while the cost performance on 13 other programs worsened over the past year. Despite decreases in this metric in the past year, the portfolio's performance for 2013 is an improvement on the 2011 portfolio, the first year we used this metric.

6. **The 10 highest-cost programs account for 59 percent of the development and procurement cost and the majority of cost growth.** As we have reported in past assessments, the total acquisition cost of the portfolio is driven in large part by the 10 costliest programs, which currently represent 59 percent of the portfolio's development and procurement cost as shown in figure 4 below.

Figure 4: Proportion of Development and Procurement Funding for the 10 Costliest Programs



Source: GAO analysis of DOD data.

Interestingly, 6 of the 10 costliest programs in the current portfolio were also in the list of 10 costliest programs in the 2004 portfolio, and if each of these programs had executed according to the baseline approved at development start, 3 of them would have completed acquisition and exited the portfolio.

Over the past year, the 10 costliest programs incurred a net cost increase of approximately \$15.4 billion, due primarily to quantity increases on the EELV program. In contrast, the other 70 programs reported a combined cost decrease of \$2.8 billion. Similarly, the 10 costliest programs also account for almost 60 percent of all cost growth—or \$124.4 billion—over the past 5 years in the current portfolio. Table 4 identifies the 10 costliest programs and lists their total acquisition cost and cost growth in the past year.

Table 4: Cost Changes in DOD's 10 Costliest Programs in Comparison to the Rest of the Current Portfolio

Fiscal Year 2014 dollars in billions

Program name	Current total estimated acquisition cost	Change in acquisition cost over the past year
F-35 Joint Strike Fighter	\$332.3	-\$11.5
DDG 51 <i>Arleigh Burke</i> Class Destroyer	107.8	2.4
<i>Virginia</i> Class Submarine	84.4	-2.3
Evolved Expendable Launch Vehicle	63.9	28.1
V-22 Osprey	60.7	0.8
F/A-18E/F Super Hornet	59.7	-1.0
Trident II Missile	55.5	0.6
KC-46 Tanker	44.5	-1.2
CVN 78 <i>Gerald R. Ford</i> Class Aircraft Carrier	36.0	-0.3
P-8A Poseidon	34.3	-0.04
10 costliest programs	\$880.0	\$15.4
Total for rest of the current portfolio	\$635.2	-\$2.8
2013 portfolio total	\$1,515.2	\$12.6

Source: GAO analysis of DOD data.

Note: Some numbers may not sum due to rounding.

- 7. The majority of the cost of the portfolio is concentrated in two system types and the amount and type of cost growth from first full estimate, as well as the schedule delay, varied significantly by system type.** Over 60 percent of the current portfolio's cost is accounted for by two system types—fixed wing manned aircraft and shipbuilding programs, both of which experienced unfavorable cost and schedule growth from first full estimates. The amount of cost growth, and whether that growth occurred in development or procurement, varied by the type of system acquired. Table 5 shows the amount of cost growth for development and acquisition unit cost experienced by each system type as well as the amount of schedule growth.

Table 5: Cost and Schedule Change since First Full Estimates by System Type

System type	Total development cost percentage increase	Procurement unit cost percentage increase	Percentage increase in time to deliver initial capabilities
Shipbuilding	113%	19%	53%
Unmanned vehicle	86	22	58
Rotary wing	78	74	30
Satellite	55	85	93
Fixed wing	43	55	34
C4ISR	42	-8	26
Munition	17	-10	16
Missile	13	79	30
Ground	5	62	19

Source: GAO analysis of DOD data.

Note: The procurement unit cost growth estimate was calculated using a weighted average based on each program's current procurement cost that gives more expensive programs a greater value. Three of the 80 programs in the current portfolio—Chemical Demilitarization-Assembled Chemical Weapons Alternatives, EELV, and Ship to Shore Connector—were not assessed here as they do not correspond with any of the nine system types used.

The development cost growth for shipbuilding programs is the greatest among all system types and, at approximately 113 percent, is more than double that experienced by the portfolio as a whole. For example, the DDG 1000 and LCS have experienced more than 342 percent and 148 percent growth, respectively, in development costs from first full estimates. Shipbuilding programs have also experienced significant schedule delays with four out of seven programs reporting delays to the delivery of initial capability of 2 years or more. We have an extensive body of work that covers the problems DOD has experienced in developing these systems.⁶

⁶GAO, *Navy Shipbuilding: Significant Investments in the Littoral Combat Ship Continue Amid Substantial Unknowns about Capabilities*, [GAO-13-530](#) (Washington, D.C.: July 22, 2013); *Ford-Class Carriers: Lead Ship Testing and Reliability Shortfalls Will Limit Initial Fleet Capabilities*, [GAO-13-396](#) (Washington, D.C.: Sept. 5, 2013); *Arleigh Burke Destroyers: Additional Analysis and Oversight Required to Support the Navy's Future Surface Combatant Plans*, [GAO-12-113](#) (Washington, D.C.: Jan. 24, 2012); *Best Practices: High Levels of Knowledge at Key Points Differentiate Commercial Shipbuilding from Navy Shipbuilding*, [GAO-09-322](#) (Washington, D.C.: May 13, 2009); and *Defense Acquisitions: Cost to Deliver Zumwalt-Class Destroyers Likely to Exceed Budgets*, [GAO-08-804](#) (Washington, D.C.: July 31, 2008).

Rotary wing systems have also experienced exceptionally high levels of development cost change, with 4 out of 9 rotary wing programs experiencing more than 150 percent growth. Rotary wing programs have also experienced high amounts of growth in procurement unit cost. As an example, both the H-1 Upgrades and CH-47F Improved Cargo Helicopter have each experienced more than 150 percent growth in their average procurement unit cost since first full estimates. Satellite programs show above average growth in development cost, procurement unit cost, and schedule growth since first full estimates when compared to the portfolio as a whole. For example, Wideband Global SATCOM and Space Based Infrared System (SIBRS) High, have each experienced more than 100 percent growth in their development costs while another satellite program, the Advanced Extremely High Frequency (AEHF) Satellite, has experienced almost 200 percent growth in its average procurement unit cost. Three satellite programs have also experienced schedule growth well above the portfolio average of 36 percent with each of them reporting delays of 4 years or more. Unmanned vehicles have also experienced greater than average schedule delays with three of six unmanned vehicle programs reporting delays of 3 years or more.

8. **DOD has already been appropriated more than \$833 billion for the current portfolio, leaving approximately \$682 billion in costs to be funded, mostly for procurement. Approximately 45 percent of the remaining cost represents growth from first full estimates. Almost two-thirds of the future funding is needed for 10 programs, with 35 percent of the total costs remaining required for the F-35 program alone.** A larger share of the current portfolio's cost is now appropriated than had been appropriated for the portfolios from 10 or even 5 years ago. Fifty-five percent of the costs for the 2013 portfolio have already been appropriated, more than \$200 billion more than in the 2004 portfolio. Forty-five percent of the total cost of the current portfolio—or \$682 billion—has not yet been funded and almost 94 percent of the remaining funding—or \$638 billion—is needed for procurement.

Approximately 45 percent—or \$311.6 billion—of that future funding is needed to cover cost growth from first full estimates for programs in the current portfolio. These funds represent resources that will not be available to support other defense or government priorities. We recognize that for some programs a portion of this cost growth from first full estimates may be attributable to a quantity increase. For

example, the \$14 billion in future funding needed for the DDG 51 *Arleigh Burke* Class Guided Missile Destroyer (DDG 51) is a result of quantity increases and the program has realized a significant decrease in its average procurement unit cost from first full estimates. However, in our assessments since 2011 we have found that a substantial amount of the change in the portfolio's total procurement cost could be attributable to factors other than quantity change such as production problems, inefficiencies, or flawed initial cost estimates. For example, the F-35 program requires \$107 billion in future funding to cover cost growth, even though it will procure 409 fewer aircraft than originally planned. Two-thirds of all remaining funding—or \$463 billion—is required by the 10 programs with the highest future funding needs and F-35 alone requires about one-third of all funding to go. The other 70 programs have only \$218.8 billion in costs remaining, less than the amount of future funding needed for the F-35 program. Table 6 shows the amount of future funding needed as well as how much of that funding represents cost growth from first full estimates.

Table 6: Future Funding and Future Funding Required Due to Cost Growth from First Full Estimates

Fiscal year 2014 dollars in billions

Program name	Future funding required	Amount of future funding due to cost growth from first full estimates
F-35 Joint Strike Fighter	\$239.6	\$107.0
Evolved Expendable Launch Vehicle	42.9	38.4
KC-46 Tanker	40.8	0
<i>Virginia</i> Class Submarine	28.2	16.2
Joint Light Tactical Vehicle	23.0	0
CH-53K Super Stallion	20.7	7.4
Littoral Combat Ship	19.6	19.6
CVN 78 <i>Gerald R. Ford</i> Class Aircraft Carrier	17.5	0
P-8A Poseidon	16.8	1.7
DDG 51 <i>Arleigh Burke</i> Class Destroyer	14.0	14.0
10 programs with the largest future funding requirements	\$463.2	\$204.3
Totals for rest of portfolio	\$218.8	\$107.3
2013 portfolio total	\$682.0	\$311.6

Source: GAO analysis of DOD data.

Notes: Future funding is measured as all fiscal year 2014 funding to completion of procurement. Some numbers may not sum due to rounding.

Observations from Our Assessment of Knowledge Attained by Programs at Key Acquisition Junctures

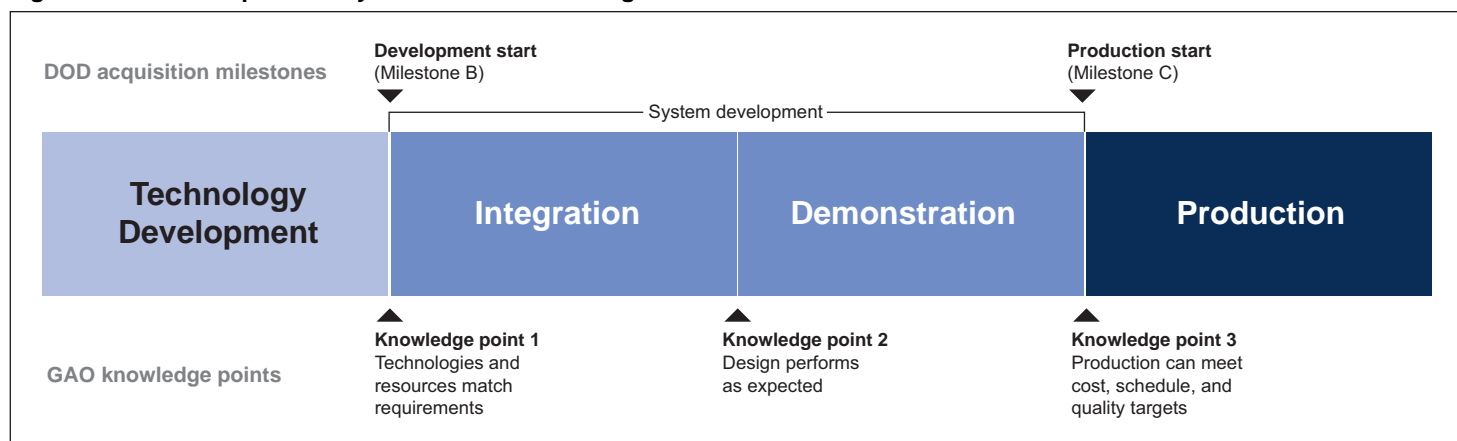
Our 2014 assessment shows that DOD continues to show progress in following a knowledge-based approach to reduce risk; however, it has significant room for improvement. While programs that have recently passed through major decision points have demonstrated best practices—such as constraining development times and achieving design stability—key practices like demonstrating technology maturity or controlling manufacturing processes are still not being fully implemented. As a result, many programs will carry risk into subsequent phases of acquisition that could result in cost growth or schedule delays.

Positive acquisition outcomes require the use of a knowledge-based approach to product development that demonstrates high levels of knowledge before significant commitments are made. In essence, knowledge supplants risk over time. In our past work examining weapon acquisition and best practices for product development, we have found that leading commercial firms and successful DOD programs pursue an acquisition approach that is anchored in knowledge, whereby high levels of product knowledge are demonstrated at critical points in the acquisition process. This work led to multiple recommendations that DOD generally or partially agreed with and has made progress in implementing.⁷ On the basis of this work, we have identified three key knowledge points during the acquisition cycle—development start, the system-level critical design review, and production start—at which programs need to demonstrate critical levels of knowledge to proceed. Figure 5 aligns the acquisition milestones described in DOD’s primary acquisition policy with these knowledge points. In this report, we refer to DOD’s engineering and

⁷GAO, *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, [GAO/NSIAD-99-162](#) (Washington, D.C.: July 30, 1999); *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, [GAO-01-288](#) (Washington, D.C.: Mar. 8, 2001); *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, [GAO-02-701](#) (Washington, D.C.: July 15, 2002); *Defense Acquisitions: A Knowledge-Based Funding Approach Could Improve Major Weapon System Program Outcomes*, [GAO-08-619](#) (Washington, D.C.: July 2, 2008); *Best Practices: High Levels of Knowledge at Key Points Differentiate Commercial Shipbuilding from Navy Shipbuilding*, [GAO-09-322](#) (Washington, D.C.: May 13, 2009); and *Best Practices: DOD Can Achieve Better Outcomes by Standardizing the Way Manufacturing Risks Are Managed*, [GAO-10-439](#) (Washington, D.C.: Apr. 22, 2010).

manufacturing development phase as system development. Production start typically refers to a program's entry into low-rate initial production.

Figure 5: DOD's Acquisition Cycle and GAO Knowledge Points



Source: GAO.

The building of knowledge consists of information that should be gathered at these three critical points over the course of a program:

Knowledge point 1: Resources and requirements match. Achieving a high level of technology maturity by the start of system development is one of several important indicators of whether this match has been made. This means that the technologies needed to meet essential product requirements have been demonstrated to work in their intended environment. In addition, the developer should complete a series of systems engineering reviews culminating in a preliminary design of the product that shows the design is feasible. Constraining the development phase of a program to 5 to 6 years is also recommended because it aligns with DOD's budget planning process and fosters the negotiation of trade-offs in requirements and technologies. For shipbuilding programs, critical technologies should be matured into actual system prototypes and successfully demonstrated in a realistic environment before a contract is awarded for detail design of a new ship.

Knowledge point 2: Product design is stable. This point occurs when a program determines that a product's design will meet customer requirements, as well as cost, schedule, and reliability targets. A best

practice is to achieve design stability at the system-level critical design review, usually held midway through system development. Completion of at least 90 percent of engineering drawings at this point provides tangible evidence that the product's design is stable, and a prototype demonstration shows that the design is capable of meeting performance requirements. Shipbuilding programs should demonstrate design stability by completing 100 percent of the basic and functional drawings as well as the three-dimensional product model by the start of construction for a new ship. Programs can also improve the stability of their design by conducting reliability growth testing and completing failure modes and effects analyses so fixes can be incorporated before production begins. At this point, programs should also begin preparing for production by identifying manufacturing risks, key product characteristics, and critical manufacturing processes.

Knowledge point 3: Manufacturing processes are mature. This point is achieved when it has been demonstrated that the developer can manufacture the product within cost, schedule, and quality targets. A best practice is to ensure that all critical manufacturing processes are in statistical control—that is, they are repeatable, sustainable, and capable of consistently producing parts within the product's quality tolerances and standards—at the start of production. Demonstrating critical processes on a pilot production line is an important initial step in this effort. In addition, production and postproduction costs are minimized when a fully integrated, capable prototype is demonstrated to show that the system will work as intended in a reliable manner before committing to production. We did not assess shipbuilding programs for this knowledge point due to differences in the production processes used to build ships.

Knowledge in these three areas builds over time. A knowledge deficit early in a program can cascade through design and production leaving decision makers with less knowledge to support decisions about when and how best to move into subsequent acquisition phases that commit more budgetary resources. Demonstrating technology maturity is a prerequisite for moving forward into system development, during which the focus should be on design and integration. A stable and mature design is likewise a prerequisite for moving forward into production where the focus should be on efficient manufacturing. Additional details about key practices at each of the knowledge points can be found in appendix IV.

For this report, we assessed the knowledge attained by key junctures in the acquisition process for 38 current weapon programs, which are mostly

in development or early production.⁸ Not all programs included in our review of knowledge-based practices provided information for every knowledge point or had reached all of the knowledge points—development start, design review, and production start—at the time of this review.

Our analysis of data from these 38 major defense acquisition programs allows us to make three observations.

Knowledge Point Observations

1. The two programs that began system development in 2013—F-22 Increment 3.2B and Air and Missile Defense Radar—did not demonstrate all their critical technologies in a realistic environment and one of the two did not complete all relevant systems engineering reviews as it failed to hold a preliminary design review prior to system development. Both programs, however, intend to constrain their development phase to 6 years or less. This is consistent with the majority of the portfolio. Of the other programs we assessed, only 4 matured their technologies and 8 completed preliminary design review in time for system development, but 19 planned for a constrained development phase.
2. Of the three programs that held critical design reviews in 2013—KC-46 Tanker, Joint Light Tactical Vehicle, and Warfighter Information Network-Tactical Increment 3—two demonstrated design stability by releasing 90 percent of planned engineering drawings and all three satisfied some of the best practices related to preparation for production; but none tested an early system-level integrated prototype or demonstrated all program critical technologies in a realistic environment prior to design review. For the other programs we assessed that reported information on this review, only 6 fully matured their designs and 3 tested system-level prototypes by the time this review was held. Significant numbers had conducted activities to plan for production.
3. The two programs that held production decisions since our last assessment—Paladin Integrated Management and Ground/Air Task Oriented Radar—reported mature technologies and stable designs. Only one demonstrated performance through the testing of a production-representative prototype. Consistent with our prior assessments, neither program has demonstrated that all their critical manufacturing processes are in statistical control, and only one program used a pilot production line before beginning production. Few of the other programs in our assessment that held production decisions implemented these practices; 3 had critical processes in control and 6 had used a pilot production line.

Additional detail about these observations follows.

⁸Because knowledge points and best practices differ for shipbuilding programs, we exclude the five shipbuilding programs from some of our analysis at each of the three knowledge points.

-
- 1. The two programs that began system development in 2013 completed two systems engineering reviews before beginning development and plan to constrain their development phase, but one program did not carry out a preliminary design review, and neither demonstrated all its critical technologies in a realistic environment.** Both the F-22 Increment 3.2B and the Air and Missile Defense Radar (AMDR) programs entered system development with critical technologies nearing maturity—that is, demonstrated in a relevant environment—in accordance with DOD policy and statutory requirements.⁹ Knowledge-based acquisition practices, however, recommend that programs fully mature technologies and demonstrate them in a realistic or operational environment prior to entering system development. Achieving this higher level of technology maturity is a better indicator of whether a program has achieved a resource and requirements match with the attainment of additional knowledge about the technologies’ form, fit, and function, as well as the effect of the intended environment on those technologies.¹⁰ Neither the F-22 Increment 3.2B nor the AMDR programs satisfied this best practice and the lower maturity level attained by these programs is consistent with our observations in past assessments on programs entering system development. Figure 6 shows the extent to which recommended acquisition practices for knowledge point 1 have been implemented on F-22 Increment 3.2B and AMDR as well as the other 36 programs we assessed.

⁹According to DOD policy at the time of our questionnaire, technology should be demonstrated in a relevant environment or, preferably, in an operational environment. In addition, a major defense acquisition program generally may not receive approval for development start until the milestone decision authority certifies that the technology in the program has been demonstrated in a relevant environment. 10 U.S.C. § 2366b(a)(3)(D).

¹⁰Demonstration in a relevant environment is Technology Readiness Level (TRL) 6. Demonstration in a realistic environment is TRL 7. See app. V for detailed description of TRLs.

Figure 6: Implementation of Knowledge-Based Practices for Programs in System Development

Knowledge-based practices at development start	F-22 Inc 3.2 B		AMDR		Other 36 programs	
	●	○	●	○	---	
Demonstrate all critical technologies in a relevant environment	●	●	15	11	10	
Demonstrate all critical technologies in a realistic environment	○	○	4	22	10	
Complete system functional review and system requirements review before development start	●	●	10	25	1	
Complete preliminary design review before development start	●	○	8	22	6	
Constrain development phase to 6 years or less	●	●	19	4	13	

● Practice implemented

○ Practice not implemented

--- Practice not applicable or information not available per the program office response

Source: GAO analysis of DOD data.

Of the remaining 36 current programs we assessed, only 4—Excalibur Precision 155mm Projectiles (Increment 1b), Global Positioning System III, LHA 6 *America* Class Amphibious Assault Ship, and Ship-to-Shore Connector—reported that all their critical technologies were matured to best practice standards when they began development.¹¹ Another 11 programs we assessed reported having all critical technologies nearing maturity prior to system development. The remaining 21 programs reported either having one or more immature technologies at the start of development or reported no information on technology maturity at this critical point in the acquisition process. Of

¹¹The MQ-9 Reaper program also reported all critical technologies as fully mature at development start. However, that technology assessment reflects the Reaper Block 5 configuration and not the original program. Our historical data shows that the Reaper program began development in 2004 with its technologies nearing maturity.

the 15 programs that had reported their critical technologies as at least nearing maturity at development start, 9 have thus far constrained research and development cost growth to 15 percent or less since first full estimate. In contrast, for the 11 programs reporting one or more immature critical technologies at development start, only 2 successfully constrained research and development cost growth to 15 percent or less since their first full estimate.

Knowledge-based acquisition best practices recommend and statute requires that programs hold systems engineering events, such as a preliminary design review, before the start of development to ensure that requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints. The Weapon Systems Acquisition Reform Act of 2009 (WSARA) made it a statutory requirement that major defense acquisition programs generally hold a preliminary design review before the start of system development.¹² According to the program offices, the F-22 Increment 3.2B program conducted a preliminary design review prior to entering system development, but the AMDR program did not, and instead sought and received a waiver to this requirement. Currently, AMDR plans to conduct a preliminary design review in June 2014. Of the remaining 36 current programs we assessed, only 8 held a preliminary design review prior to development start, including 4 programs that began development start before 2009, and another 4 programs that started development after implementation of WSARA. Our analysis of the current portfolio shows that programs that conducted a preliminary design review prior to development start have, on average, experienced a lower rate of research and development cost growth and a lower rate of total acquisition cost growth, compared with programs that did not have a preliminary design review before development start. Of the eight assessed programs that held this review prior to development start, six have thus far constrained research and development cost growth to less than 15 percent since first full estimate. Of the 22 assessed programs that did not carry out a

¹²Pub. L. No. 111-23, § 205(a). A major defense acquisition program may not receive milestone B approval until the program has held a preliminary design review and the milestone decision authority has conducted a formal post-preliminary design review assessment and certified on the basis of such assessment that the program demonstrates a high likelihood of accomplishing its intended mission unless a waiver is properly granted by the milestone decision authority. 10 U.S.C. § 2366b(a)(2), (d)(1).

preliminary design review prior to development start, only 8 were successful in restraining development cost growth below 15 percent.

In addition to the preliminary design review, knowledge-based acquisition best practices recommend the completion of two additional systems engineering reviews: one review to ensure that system requirements have been properly identified, which helps ensure mutual understanding between government and contractor; and a system functional review to establish a functional baseline for the system. Both the F-22 Increment 3.2B and AMDR programs completed these reviews prior to entering system development. Of the remaining 36 programs we assessed, only 10 completed both reviews prior to development start—five that entered system development before 2009 and another 5 that began system development after 2009.

Knowledge-based acquisition practices also recommend that a program constrain the development phase to just 5 or 6 years, and both the F-22 Increment 3.2B and AMDR programs plan to do so.¹³ By limiting development time in this manner, a program increases the predictability of funding needs, as well as the likelihood of program success by fostering the negotiation of trade-offs in requirements and technologies.¹⁴ For the remaining 31 non-ship programs we assessed, 19 had plans to limit their development phases to 6 years or less at the time of development start. This includes 13 out of 23 programs that began development prior to 2009 and another 6 out of 8 programs that began system development during or after 2009.

As part of our analysis, we also assessed 18 future programs that expect to become major defense acquisition programs. These programs provided information on the knowledge they planned to obtain and best practices they intend to implement before their development start is approved. Seven of 18 future programs reported

¹³We did not assess shipbuilding programs against this recommended practice to limit the development phase, as their development cycles do not align in a manner consistent with other programs.

¹⁴DOD policy in place at the time of our review provided that a condition for exiting the technology development phase is that a system or increment be developed for production within a short time frame, defined as normally less than 5 years for weapon systems. Department of Defense Instruction 5000.02, *Operation of the Defense Acquisition System*, enc. 2, para. 5.d(7) (Dec. 8, 2008) (hereinafter cited as DODI 5000.02 (Dec. 8, 2008)). An interim version of this instruction was issued in November 2013.

that their technologies are expected to be nearing maturity; that is demonstrated in a relevant environment, at the time of development start. Ten of the future programs plan to hold a preliminary design review before the start of development and only seven plan to conduct both a system functional and system requirements review before the start of development. Nine of the future programs reported plans to limit the program development phase to 6 years or less. If these plans continue unaltered, programs will enter system development with insufficient knowledge about their ability to meet cost, schedule, and performance requirements. The decision to proceed without this knowledge involves more than the program at hand, it sends signals across the portfolio of programs on what is acceptable. If programs that do not abide by sound acquisition principles win funding, then seeds of poor outcomes are planted. Top decision makers must ensure that new programs exhibit desirable principles before they are approved and funded; the proper time to establish that is at program start.

2. **Of the three programs that held critical design reviews in 2013, two demonstrated design stability by releasing 90 percent of expected engineering drawings, but none tested an early integrated prototype or demonstrated all critical technologies in a realistic environment prior to this design review.** Knowing a product's design is stable before system demonstration reduces the risk of costly design changes as manufacturing begins and investments in acquisition become more significant. Just as programs that enter system development with immature technologies cost more and take longer to deliver their operational capabilities to the warfighter, programs that hold their critical design review before achieving a stable design also experience higher average costs and longer schedule delays. Figure 7 presents whether the programs implemented this, as well as other, best practices.

Figure 7: Implementation of Knowledge-Based Practices for Programs at Critical Design Review

Knowledge-based practices at critical design review	JLTV	KC-46	WIN-T INC 3	●	○	---
Demonstrate all critical technologies in a realistic environment	○	○	○	6	18	6
Release at least 90 percent of drawings or 100 percent of 3D zones	●	●	---	6	18	6
Test a system-level integrated prototype	○	○	○	3	18	9
Establish a reliability growth curve	●	●	●	14	12	4
Identify key product characteristics	●	●	●	26	1	3
Identify critical manufacturing processes	○	●	●	21	3	6
Conduct producibility assessments to identify manufacturing risks for key technologies	●	●	---	23	3	4
Complete failure modes and effects analysis	●	●	---	21	4	5

● Practice implemented
 ○ Practice not implemented
 --- Practice not applicable or information not available per the program office response

Source: GAO analysis of DOD data.

Of the three programs that held their critical design review in 2013, both the KC-46 Tanker and the Joint Light Tactical Vehicle (JLTV) demonstrated design stability by releasing over 90 percent of each program's expected design drawings.¹⁵ According to the Warfighter Integration Network-Tactical Increment 3 (WIN-T Inc 3) program office this practice was not applicable as the system relies primarily on

¹⁵According to JLTV program officials, a series of design understanding reviews were held with each of the program's three current contractors that served as the equivalent of a single critical design review. At the time of these reviews, all long-lead and critical designs had been completed and all three contractors had more than 90 percent of the design files under configuration control.

software for its functionality.¹⁶ Of the remaining programs we assessed, 30 reported information about the practices they implemented at their critical design review. Of these, only 6 non-ship programs released at least 90 percent of their total expected design drawings before holding this review, and no shipbuilding programs met the shipbuilding-specific best practice of completing 100 percent of their three-dimensional design models prior to the start of fabrication. All 6 of the programs with a stable design held their critical design review since 2009.

The use of early system prototypes during development is another useful practice for demonstrating that a system has a stable design, will work as intended, and can be built within cost and schedule. None of the three programs reported testing an integrated system prototype before their critical design review or its equivalent. Instead, the JLTV program reported conducting this system prototype testing 7 months after its design review, and the KC-46 Tanker program will not begin flight testing a system-level prototype that integrates the civilian aircraft and military sub-systems until January 2015, 18 months after its critical design review. WIN-T Inc 3 did not plan to test a system-level prototype until October 2015, 22 months after its critical design review. Of the 25 non-ship programs we assessed that have held a critical design review, 21 report they tested or plan to test an early integrated prototype but only 3 programs conducted this testing before their critical design review.¹⁷ For the other 18 programs, prototype testing followed the review by an average of nearly 3 years (or 33 months). This use of early system prototypes among programs we assessed is much the same as past assessments.

Reliability growth testing provides visibility over how reliability is improving and uncovers design problems so fixes can be incorporated before production begins. All three programs reported establishing a reliability growth curve by their critical design review. Of the remaining

¹⁶While the WIN-T Inc 3 program held a critical design review in December of 2013 that assessed the entirety of the developmental program, it later had its requirements and capabilities reduced through descoping options recommended at a configuration steering board review and approved by the Army acquisition executive in January 2014.

¹⁷We did not assess the five shipbuilding programs against this recommended practice as testing early system prototypes in these programs may not be practical.

30 programs we assessed that have held critical design review, or its equivalent, 14 had a reliability growth curve at that time.

The programs we assessed also reported use of other knowledge-based practices to increase confidence in the stability of their product's design. Those practices include the identifying key product characteristics; identifying critical manufacturing processes; conducting producibility assessments to identify manufacturing risks; and completing failure modes and effects analysis to identify potential failures and early design fixes. The KC-46 Tanker program carried out all four of these practices, while the JLTV program carried out three and the WIN-T Inc 3 program implemented two. For the 30 other programs we assessed with a critical design review prior to 2013, a little more than half of them reported having used all four of these practices. This rate of implementation is similar to what we observed in our prior year assessment.

- 3. The two programs that held production decisions since our last assessment reported mature technologies and stable designs, and one of the two demonstrated performance through the testing of a production-representative prototype; neither demonstrated that all their manufacturing process capabilities were in control.** Capturing critical manufacturing knowledge before entering production helps ensure that a weapon system will work as intended and can be manufactured efficiently to meet cost, schedule, and quality targets. This knowledge can be captured and demonstrated through the use of various proactive methods, including the use of statistical process control data, pilot production lines, manufacturing readiness levels, and prototype testing. Figure 8 shows the extent to which programs that have held a production decision have implemented associated knowledge-based practices.

Figure 8: Implementation of Knowledge-Based Practices for Programs at Production Decision

Knowledge-based practices at production start			Other 16 programs		
	PIM	G/ATOR	●	○	---
Demonstrate all critical technologies in a realistic environment	●	●	8	4	4
Release at least 90 percent of drawings	●	●	6	5	5
Demonstrate manufacturing process capabilities are in control	○	○	3	7	6
Demonstrate critical processes on a pilot production line	○	●	6	4	6
Test a production-representative prototype in its intended environment	○	●	6	5	5

● Practice implemented
 ○ Practice not implemented
 --- Practice not applicable or information not available per the program office response

Source: GAO analysis of DOD data.

Neither the Paladin Integrated Management (PIM) program, which held a production decision in 2013, nor the G/ATOR program, which held a production decision in January 2014, demonstrated that their manufacturing process capabilities were in control at production start.¹⁸ Of the remaining programs we assessed, 16 non-ship programs held production decisions prior to 2013, of which only 3 provided data indicating that critical manufacturing processes were in control at production start.¹⁹ Though the PIM program did not test a pilot production line prior to production start, the G/ATOR program reported that it has. Of the 16 programs that held production decisions prior to

¹⁸To determine whether critical processes are in control, we used program reported process capability index data and manufacturing readiness level assessments of the process capability and control sub-thread.

¹⁹The five shipbuilding programs we assessed were excluded from this portion of our analysis due to the differences in the production processes used to build ships.

2013, only 6 have demonstrated manufacturing processes on a pilot production line. Another 14 programs we assessed plan to hold a production decision in the future and only 6 indicated that they intend to test a pilot production line before production start.

Production and postproduction costs are also minimized when a fully integrated, production-representative prototype is demonstrated to show that the system will work as intended in a reliable manner. DOD policy has also required that a system be demonstrated in its intended environment using a production-representative article before entering production, which has led to an increase in the number of programs doing so.²⁰ The G/ATOR program has tested a production-representative prototype in its intended environment in advance of their production decision, but PIM has not. Of the 16 programs we assessed that held a production decision prior to 2013, only 6 tested production-representative prototypes prior to their production start. For the other 14 programs we assessed that plan to hold a production decision in the future, only 5 currently have plans to test a production-representative prototype before reaching this key juncture. In not testing such prototypes these programs risk repeating the experiences of the past when issues were discovered late in testing, triggering the need for expensive re-tooling of production lines and retrofitting of production articles.

Observations about DOD's Implementation of Key Acquisition Reform Initiatives and Program Concurrency

During the past few years, the Congress and DOD have made policy changes and begun other reform initiatives to improve the way the department acquires major weapon systems and address the symptoms of an acquisition system that include frequent program cost overruns and delays in operational capability delivery. More specifically, the enactment of the Weapon Systems Acquisition Reform Act of 2009, the promulgation of multiple "Better Buying Power" memorandums by the Under Secretary of Defense for Acquisition, Technology, and Logistics, and the revision of DOD Instruction 5000.02 in 2008 and interim revision in 2013, represent efforts to increase competition in weapon programs, decrease acquisition

²⁰DODI 5000.02, enc. 2, para. 6.c(6)(d) (Dec. 8, 2008).

costs, and ensure that programs are more affordable.²¹ We focused our analysis on efforts within the “Better Buying Power” memorandums, particularly affordability constraints and “should-cost” analysis. These efforts attempt to control program costs by introducing, respectively, constraints on total cost and a review process to eliminate unnecessary costs from contracts. We also analyzed the implementation of two reforms addressed in legislation, the requirement to increase competition throughout the acquisition life cycle and the requirement that major defense acquisition programs hold annual configuration steering board reviews to consider changes regarding program requirements and maximize capabilities. GAO has previously made recommendations or observations on the implementation of a number of these reform initiatives and DOD, which has generally concurred or partially concurred with the recommendations, is working to implement them.²² In addition, we evaluated the amount of concurrency between developmental testing and production for programs we assessed that have started production as well as those that plan to begin production in the coming years.²³ We have consistently emphasized the importance of completing developmental

²¹Pub. L. No. 111-23. Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Better Buying Power: Mandate for Restoring Affordability and Productivity in Defense Spending” (June 28, 2010). Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending” (Sept. 14, 2010). Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Implementation Directive for Better Buying Power - Obtaining Greater Efficiency and Productivity in Defense Spending” (Nov. 3, 2010). Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending” (Nov. 13, 2012). DODI 5000.02 (Dec. 8, 2008) and Interim DODI 5000.02, *Operation of the Defense Acquisition System* (Nov. 25, 2013). As our data was collected prior to the release of the latest revision of DODI 5000.02, we did not use the new instruction as criteria for our assessments.

²²GAO, *Weapons Acquisition Reform: Reform Act Is Helping DOD Acquisition Programs Reduce Risk, but Implementation Challenges Remain*, [GAO-13-103](#) (Washington, D.C.: Dec. 14, 2012); *Defense Acquisitions: DOD Can Improve Its Management of Configuration Steering Boards*, [GAO-11-640](#) (Washington, D.C.: July 7, 2011); *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-13-294SP](#) (Washington, D.C.: Mar. 28, 2013).

²³This analysis reflects 30 non-ship programs out of the 38 programs we assessed and does not include three non-ship programs for which a production start date was not identified as well as five shipbuilding programs. Shipbuilding programs are excluded from this analysis as we assess production knowledge for ships differently.

testing before entering production, and pointed out the increased risks associated with concurrent testing and production.²⁴

To gain some perspectives on the implementation of key aspects of policy changes and reform initiatives within DOD's current portfolio, we analyzed questionnaire data collected from 38 current major defense acquisition programs—the same programs reflected in our knowledge point analysis—and 18 additional programs identified by DOD as future major defense acquisition programs.

Implementation of the reform initiatives we analyzed varies across programs. The department has largely been successful in implementing its “should-cost” initiative with significant cost savings being reported. In addition, many programs reported holding configuration steering board reviews. In contrast, the department has had less success in implementing affordability constraints and utilizing measures to ensure competition before and after development start—initiatives that also have the potential to result in savings. In addition, many programs are committing to production prior to completing the developmental testing necessary to assure that the system will function as intended, introducing unnecessary risk to cost and schedule. Our current analysis allows us to make the following five observations concerning key acquisition reform initiatives and program concurrency.

²⁴ GAO, *Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks*, [GAO-12-437](#) (Washington, D.C.: June 14, 2012); *Missile Defense: Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency*, [GAO-12-486](#) (Washington, D.C.: Apr. 20, 2012); and *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, [GAO-02-701](#) (Washington, D.C.: July 15, 2002).

Acquisition Reform and Concurrency Observations

1. Only 30 of the 56 current and future programs we assessed have established an affordability constraint, an implementation rate that has not improved from our prior year assessment, but all programs with a cap that we assessed reported they are on track to meet it.
2. About 82 percent of the current programs we assessed have conducted a “should-cost” analysis resulting in anticipated savings of approximately \$24 billion; over half of this amount has or will be reallocated from these programs for other priorities.
3. Many of the future programs we assessed do not plan to conduct competitive prototyping before development start and many current programs do not have acquisition strategies that ensure competition through the end of production. Fifteen future and current programs reported they will not take actions to promote any competitive measures before or after development start.
4. All but 1 of the 38 current programs we assessed had conducted a configuration steering board review with 29 programs reporting that this review occurred during the past year. Only 10 programs reported that changes were approved or recommended at their last review.
5. Fifteen of the 18 current programs we assessed that have started production plan to perform 30 percent or more of their developmental testing during production despite the increased risk of design changes and costly retrofits. Five of these programs expect to place substantial procurement quantities under contract before developmental testing is completed.

Additional details about each observation follow.

1. **Only 30 of the 56 current and future programs we assessed have established an affordability constraint, an implementation rate that has not improved from our prior year assessment, but all programs with a cap that we assessed reported they are on track to meet it.** In September 2010, the first of several memorandums were issued by the Under Secretary of Defense for Acquisition, Technology, and Logistics directing programs to consider affordability a key program requirement and outlining how this initiative was to be

implemented across the department.²⁵ The memorandums emphasize the need to treat affordability, defined as conducting a program at a cost constrained by the resources that DOD can allocate, as a key requirement at the start of development. Affordability constraints are intended to force prioritization of requirements, enable cost trades and ensure that unaffordable programs do not enter the acquisition process.²⁶ More than half of the current and future programs (30 of 56) we assessed have established an affordability constraint as directed by the “Better Buying Power” initiatives and all these programs reported that they are on track to meet their established constraint. The rate of implementation of this reform has not improved from the level reported in our prior assessment. For the 38 current programs, 18 have not established an affordability cap and almost all of these programs are nearing a production decision or are already in production. In general, these 18 programs are older and have smaller percentages of funding remaining than those current programs with an affordability cap. Similarly, for the 18 future programs, 8 reported a lack of an established affordability goal. Two of them reported holding a milestone A review during 2013—where an affordability goal would normally be established—while a third program held its milestone A review in 2009 before the affordability requirement was established by DOD policy and the remaining 5 responded that the timeframe for this review was “to be determined” or “not applicable.”

2. About 82 percent of the current programs we assessed have conducted a “should-cost” analysis resulting in anticipated

²⁵Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending” (Sept. 14, 2010). Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Implementation Directive for Better Buying Power - Obtaining Greater Efficiency and Productivity in Defense Spending” (Nov. 3, 2010). Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending” (Nov. 13, 2012). Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics Memorandum: “Implementation Directive on Better Buying Power 2.0: Achieving Greater Efficiency and Productivity in Defense Spending” (Apr. 24, 2013).

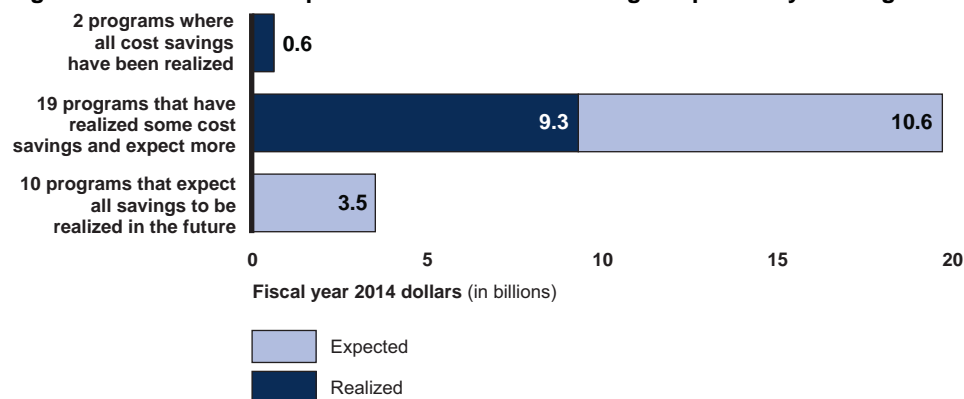
²⁶Affordability goals are established at milestone A, the entry into technology development. After systems engineering trade-offs are completed during the technology development phase, these affordability goals then become affordability caps at milestone B, the start of system development, when a match is to be made between requirements and resources. We refer to the goals and caps collectively as affordability constraints.

savings of approximately \$24 billion; over half of this amount has or will be pulled from these programs for other priorities. DOD's "Better Buying Power" initiatives also emphasize the importance of driving cost improvements during contract negotiation and program execution to control costs both in the short-term and throughout the product life cycle. In accordance with direction provided in memorandums issued by the Under Secretary, each program must conduct a "should-cost" analysis which includes justifying each cost under the program's control with the aim of reducing negotiated prices for contracts and obtaining other efficiencies in program execution. More broadly, "should-cost" is the concept that program managers are to proactively control expenditures by setting cost targets below what has been budgeted for their program's activities and manage with the intent to achieve these lower targets.

According to our analysis of questionnaire responses, 32 of 38 current programs we assessed conducted a "should-cost" analysis as directed by the "Better Buying Power" initiatives and 31 of the programs reported that they had realized or expect to realize cost savings totaling approximately \$24 billion in fiscal year 2014 dollars as shown in figure 9 below.²⁷

²⁷One of the 32 programs that conducted a "should-cost" analysis—the LCS program—reported "should-cost" savings of \$5.8 billion in then-year dollars, which were not comparable to the base year data we received from other programs and is not reflected in the \$24 billion fiscal year 2014 constant dollar amount.

Figure 9: Realized and Expected “Should-Cost” Savings Reported by 31 Programs



Source: GAO analysis of questionnaire data.

Approximately 41 percent, \$9.9 billion, of all the “should-cost” savings were identified as realized, with the other 59 percent, or \$14.1 billion, expected in the future. When savings were converted into fiscal year 2014 constant dollars, 6 of the programs reported savings of more than \$1 billion, the largest of which was the KC-46 Tanker program which reported a savings total of \$6.8 billion with nearly \$6.4 billion of this amount already realized. For the 6 current programs that reported they did not conduct a “should-cost” analysis, 3 were being restructured during our assessment after reporting an increase in cost or schedule above their acquisition program baselines, and another had recently entered system development.

The 18 programs that reported some or all of their “should-cost” savings as realized cited several activities as being responsible including

- improved vendor/supply chain management (10 programs),
- developmental or operational testing efficiencies (12 programs), and
- design trades conducted to balance affordability and capability (12 programs).

As a specific example, the DDG 51 program reported that nine different activities were carried out to obtain approximately \$506 million in realized cost savings including the three activities above, while the

JLTV program cited two activities—design trades balancing affordability and capability and changes in requirements—to achieve \$206 million in realized cost savings with another \$412 million in savings expected in the future. These savings may manifest themselves in the program by lower contract prices, lower program cost estimates, and possibly lower funding requests.

Achieving efficiency needs to be done with caution as the short-term savings could come at the expense of long-term needs. For example, six of the programs that reported implementing testing efficiencies for savings are also planning to conduct concurrent developmental testing and production which leaves these programs at risk to deficiencies being discovered during production that could require substantial and costly modifications to systems already built. Similarly, four programs that started production before 2011 reported that changes in design or requirements will result in some savings, but carrying out this “should-cost” activity after production start could contribute to design instability. In addition, 7 programs stated that savings are being realized from the increased use of modeling and simulation but only 3 of these programs reported that all the models being used for operational and live fire testing were officially reviewed and certified as acceptable for their intended use. While the use of models and simulations can reduce the time and resources needed to conduct the required testing, using models that are not fully accredited to meet weapons system testing objectives increases the likelihood that an inappropriate or unsuitable simulation is being used.

Of the approximately \$24 billion in realized and anticipated “should-cost” savings, a total of \$12.6 billion was reallocated to meet other service and DOD priorities. For example, the KC-46 Tanker program reported that all of its “should-cost” savings, totaling \$6.8 billion, will be reinvested in other service and Office of the Secretary of Defense priorities. Approximately \$6.3 billion was reported as retained by 16 programs we assessed. While several other programs reported that their savings, a total of \$3.6 billion, were split among different activities with some amounts retained and some reallocated for other priorities. For example, the F-35 program reported that some of the \$884 million in expected savings will be put to use by the program while other amounts will be reinvested in other service and Office of the Secretary of Defense priorities. An additional \$1.5 billion in savings was reported as a part of our questionnaire but programs stated that they did not know or had not yet determined how these funds would be

re-allocated. The concept of allowing programs to keep at least some of their savings is appropriate, but the department should take care to use this incentive effectively.

Of the 18 future programs that we assessed, 6 reported that they conducted a “should-cost” analysis prior to entering system development which identified approximately \$26 billion in realized and expected savings. The vast majority of this amount was reported by the Ohio Replacement and Ground Combat Vehicle (GCV) programs with \$16 billion and \$8.5 billion, respectively, in “should-cost” savings. The Ohio Replacement program reported that all \$16 billion in procurement and other savings were expected in the future and would result from several ongoing affordability initiatives including design for producibility initiatives and potentially procuring boats in a multi-year procurement block buy with *Virginia* Class submarines. In contrast, the GCV program reported all its \$8.5 billion in savings as realized. The program claims savings were due to design trades to balance affordability and capability and the award of a fixed-price development contract among other activities. The decision to eliminate competition during system development and production was reported as responsible for a decrease in the program’s expected cost.

- 3. Many of the future programs we assessed do not plan to conduct competitive prototyping before development start and many current programs do not have acquisition strategies that ensure competition through the end of production. Fifteen future and current programs reported they will not take actions to promote any competitive measures before or after development start.** Competition is a critical tool for achieving the best return on the government’s investment. Major defense acquisition programs are required to provide for the use of competitive prototypes before a program enters system development and have acquisition strategies that ensure competition or the option of competition throughout the acquisition life cycle.²⁸ Table 7 shows the activities programs report using or plan to use to ensure competition or the possibility of competition.

²⁸Pub. L. No. 111-23, §§ 202, 203.

Table 7: Use of Activities to Ensure Competition Reported by Future and Current Programs

Activity to ensure competition is utilized ^a		Of the 18 future programs	Of the 38 current programs
Competitive prototyping prior to development start	Competitive prototyping planned or conducted	9	16
	No competitive prototyping planned or conducted	8	22
Measures to ensure competition after development start included in program strategy ^b	Measures to ensure competition are planned or have taken place	8	21
	No measures included	8	17
	Actions taken to promote competition both prior to and after development start	5	10
	No actions taken to promote competition	4	11

Source: GAO analysis of questionnaire data.

^aOne future program—the Amphibious Combat Vehicle—was not included in the totals above for competitive prototyping as it did not know whether such a competition would be conducted prior to development start. Two future programs—the Amphibious Combat Vehicle and Indirect Fire Protection Capability Increment 2—were not counted in the totals for measures to ensure competition as they both did not know whether their technology development or acquisition strategies would call for competition between development start and the completion of production.

^bWe use program strategy to refer to both technology development strategies used by future programs and the acquisition strategies used by current programs.

Only 25 of 56 current and future programs we assessed reported conducting or planning for any form of competitive prototyping prior to the start of system development. Of the 22 current programs with no competitive prototyping, only 2 reported that the requirement was waived pursuant to DOD policy implementing WSARA. The other 20 programs that reported the competitive prototyping requirement was not waived either began development before December 2009, when WSARA was implemented, or proceeded directly to production. The future programs we assessed reported that they plan to conduct competitive prototyping at a slightly higher rate than the current programs we assessed. However, 8 future programs still reported that they do not intend to conduct competitive prototyping. Of these, 7 plan to seek a waiver to this requirement with the remaining one reporting that the requirement to seek a waiver was not applicable.

Measures in a program's acquisition strategy to ensure competition or the option of competition after a program enters system development may include approaches such as the use of modular, open architectures to enable competition for upgrades or the use of build-to-print approaches to enable production through multiple

sources.²⁹ But as shown in table 7 above, only 29 of 56 current and future programs reported that their acquisition strategies currently include measures to ensure competition after the start of development. Twenty-six of these programs stated that some or all of their activities to promote competition will take place in the future.

Overall, only 10 current programs and 5 future programs have taken or plan to take actions to promote competition both before and after the start of the development. In contrast, 11 current programs and 4 future programs reported that they have not taken any actions, nor do they plan to take any, to ensure competition or the option of competition for acquisition at any point after program initiation. This does not mean that these programs will have no competition at any point during their acquisition; only that they do not intend to ensure competition through the specific activities we assessed.

- 4. All but one of the 38 current programs we assessed had conducted a configuration steering board (CSB) review, 29 reported that this review occurred during the past year. Only 10 programs reported that proposed changes were approved or recommended at the most recent review.** According to statute and DOD's acquisition policy at the time of our review, major defense acquisition programs are required to conduct annual configuration steering boards to review proposed changes to the program's requirements or significant technical configuration changes that may impact cost and schedule performance.³⁰ Thirty-seven current programs we assessed had conducted such a review. The Air and Missile Defense Radar program was the only exception, as it just started development in October 2013 and was not required to complete the review by the time of our assessment. A majority, 29 out of 37 programs, reported that this review occurred in the 12 months prior to the submission of our questionnaire.

²⁹Open systems architecture is a design approach that includes standard interfaces and the use of modular components within a product (like a computer) that can be replaced easily. This allows the product to be refreshed with new, improved components made by a variety of suppliers.

³⁰Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Pub. L. No. 110-417, § 814 (2008).

Only 12 of the current programs we assessed reported presenting any changes at their last CSB review. Of these, 10 programs had proposed requirements changes, configuration changes, descoping options, or some combination of these, which they reported were approved or recommended for approval. For example, the DDG 1000 *Zumwalt* Class Destroyer program reported that both configuration changes and descoping options were approved or recommended for approval at their June 2012 review, while the F-35 program reported that requirements changes were approved or recommended at their March 2013 review. However, some changes to capabilities have occurred outside of the CSB process. For the 38 current programs we assessed, 14 reported that planned system capabilities have either increased or decreased since the start of development. Only 5 of these programs indicated that a CSB review was one of the contributing reasons for the change. Many of these 14 programs reported that requirements changes since development start have caused cost and schedule changes as well.

5. Fifteen of the 18 current programs we assessed that have started production plan to perform 30 percent or more of their developmental testing during production despite the increased risk of design changes and costly retrofits. Five of these programs expect to place substantial procurement quantities under contract before developmental testing is completed.

Beginning production before demonstrating that a design is mature and that a system will work as intended increases the risk of discovering deficiencies during production that could require substantial design changes and costly modifications to systems already built. The intent of developmental testing is to demonstrate the maturity of a design and to discover and fix design and performance problems before a system enters production. However, 15 out of the 18 programs we assessed that have started production intend to or have already executed 30 percent or more of their developmental testing concurrent with production. Seven of these 15 programs have completed developmental testing with 4 of them reporting quality problems during production.

Five of the other 8 programs currently conducting concurrent testing and production, expect to have more than 10 percent of their procurement quantities under contract before developmental testing completes. The F-35 program in particular plans to have 530 aircraft, more than 20 percent of its total procurement quantity, under contract

at a cost of approximately \$57.8 billion before developmental testing is completed in 2017.³¹ When considering the point at which budgets to support those procurements are typically approved—up to 18 months in advance—it places the commitment of funding that much further ahead of the completion of developmental testing.

Another twelve programs we assessed are scheduled to make a production decision in the coming years and 6 of them intend to execute 30 percent or more of their developmental testing concurrent with production. Two out of these six programs expect to have more than 10 percent of their total procurement quantity under contract before developmental testing is finished running the risk of costly retrofits to existing systems or changes to active production lines.

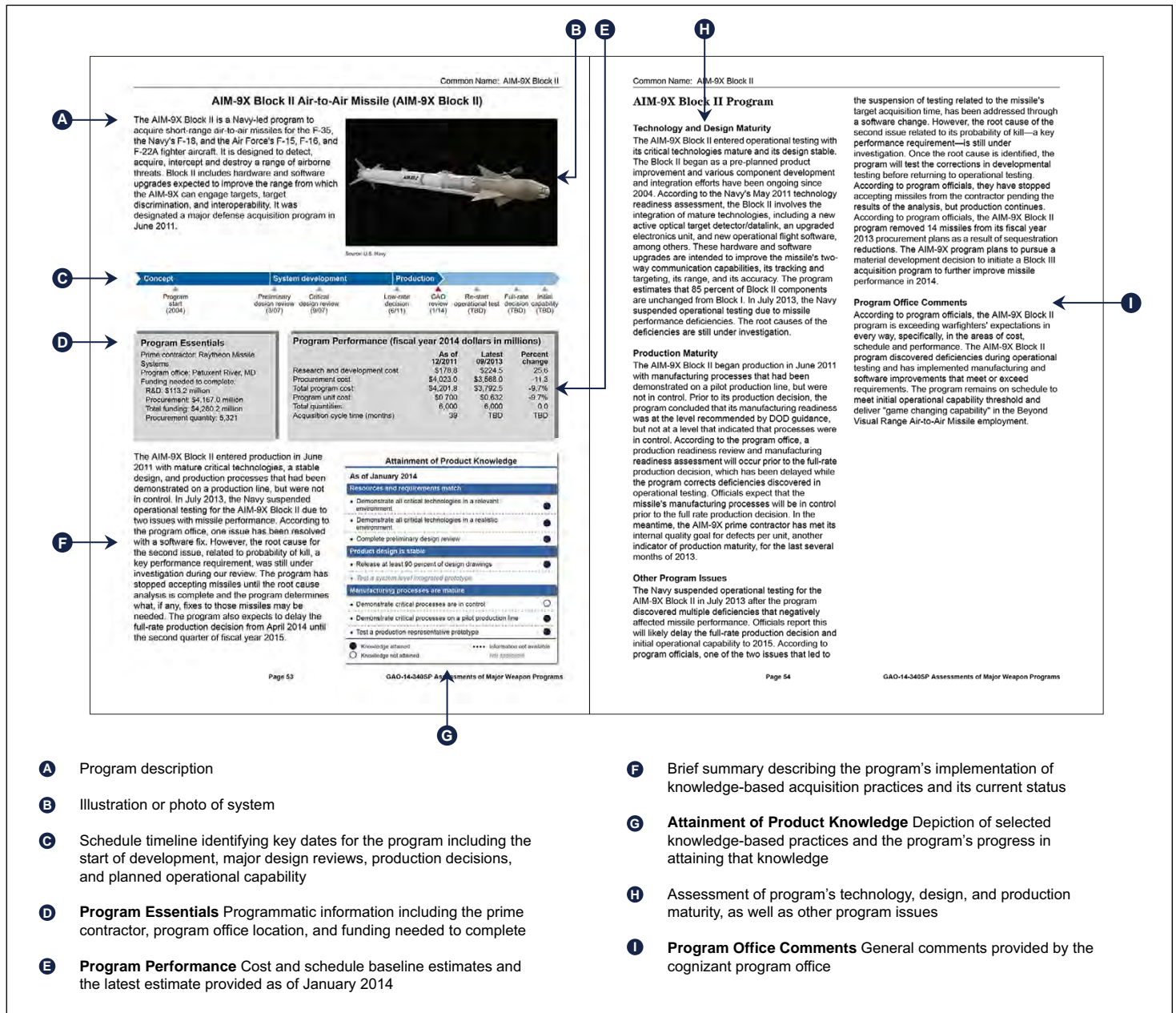
Assessments of Individual Programs

This section contains assessments of individual weapon programs. Each assessment presents data on the extent to which programs are following a knowledge-based acquisition approach to product development, and other program information. In total, we present information on 56 programs. For 37 programs, we produced two-page assessments discussing the technology, design, and manufacturing knowledge obtained, as well as other program issues. Each two-page assessment also contains a comparison of total acquisition cost from the first full estimate for the program to the current estimate. The first full estimate is generally the cost estimate established at development start; however, for a few programs that did not have such an estimate, we used the estimate at production start instead. For shipbuilding programs, we used their planning estimates if those estimates were available. For programs that began as non-major defense acquisition programs, we used the first full estimate available. Thirty-four of these 37 two-page assessments are of major defense acquisition programs, most of which are in development or early production and 3 assessments are of programs that were projected to become major defense acquisition programs during or soon after our review. See figure 10 for an illustration of the layout of each two-page assessment. In addition, we produced one-page assessments on the

³¹The cost of the F-35 aircraft under contract before the completion of developmental testing was calculated using the average procurement unit cost for both the airframe and engine as reported in the program's December 2012 Selected Acquisition Report. This unit cost estimate assumes the quantity benefits from additional purchases of F-35 aircraft by international partners and other foreign military sales.

current status of 19 programs, which include 15 future major defense acquisition programs, 2 major defense acquisition programs that are well into production, and 2 major defense acquisition programs that were recently restructured or curtailed.

Figure 10: Illustration of Program Two-Page Assessment



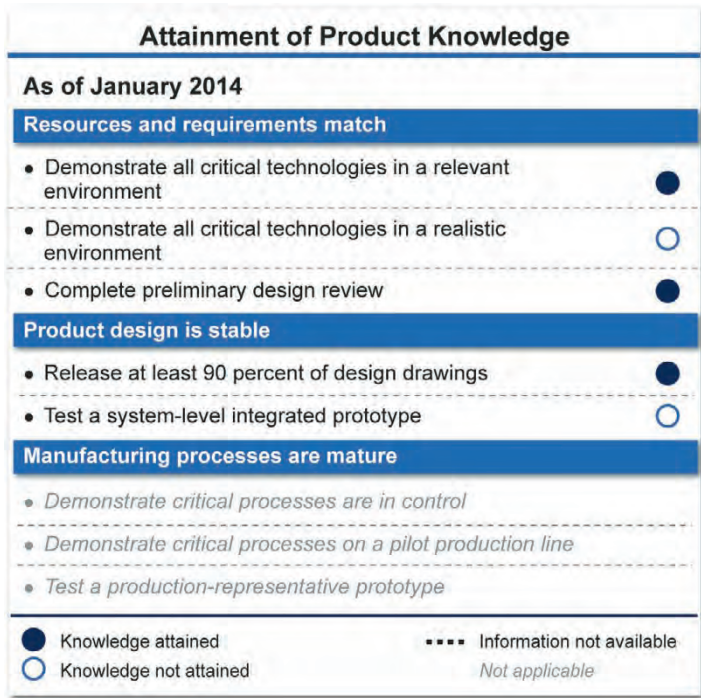
Source: GAO analysis.

For our two-page assessments, we depict the extent of knowledge gained in a program by the time of our review with a scorecard and narrative summary at the bottom of the first page of each assessment. As illustrated in figure 10 above, the scorecard displays eight key knowledge-based acquisition practices that should be implemented by certain points in the acquisition process. The more knowledge the program has attained by each of these key points, the more likely the weapon system will be delivered within its estimated cost and schedule. A knowledge deficit means the program is proceeding without sufficient knowledge about its technologies, design, or manufacturing processes, and faces unresolved risks that could lead to cost increases and schedule delays.

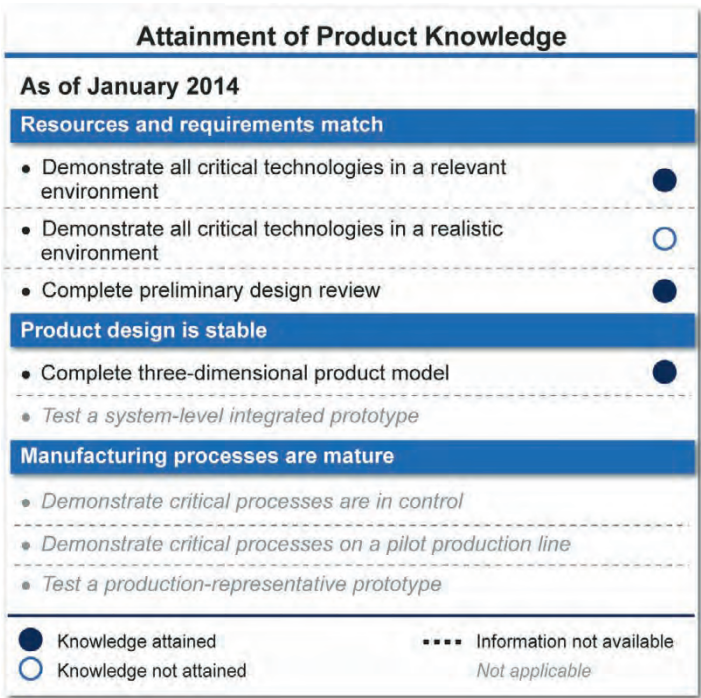
For each program, we identify a knowledge-based practice that has been implemented with a closed circle. We identify a knowledge-based practice that has not yet been implemented with an open circle. If the program did not provide us with enough information to make a determination, we show this with a dashed line. A knowledge-based practice that is not applicable to the program is grayed out. A knowledge-based practice may not be applicable to a particular program if either the point in the acquisition cycle when the practice should be implemented has not yet been reached, or if the particular practice is not relevant to the program. For programs that have not yet entered system development, we show a projection of knowledge attained for the first three practices. For programs that have entered system development but not yet held a critical design review, we assess actual knowledge attained for these three practices. For programs that have held a critical design review but not yet entered production, we assess knowledge attained for the first five practices. For programs that have entered production, we assess knowledge attained for all eight practices.

We make adjustments to both the key points in the acquisition cycle and the applicable knowledge-based practices for shipbuilding programs. For shipbuilding programs that have not yet awarded a detailed design contract, we show a projection of knowledge attained for the first three practices. For shipbuilding programs that have awarded this contract but not yet started construction, we would assess actual knowledge attained for these three practices. For shipbuilding programs that have started construction, we assess the knowledge attained for the first four practices. We do not assess the remaining four practices for shipbuilding programs. See figure 11 for examples of the knowledge scorecards we use to assess these different types of programs.

Figure 11: Examples of Knowledge Scorecards
Program in production



Shipbuilding program



Source: GAO.

Statement on Small
Business Participation

Pursuant to a mandate in the report accompanying the National Defense Authorization Act for Fiscal Year 2013, we reviewed whether individual subcontracting reports from a program’s prime contractor or contractors were accepted on the Electronic Subcontracting Reporting System (eSRS).³² We reviewed this information for 36 of the major defense acquisition programs in our assessment using the contract information reported in available Selected Acquisition Reports. The contract numbers for each program’s or element’s prime contracts were entered into the eSRS database to determine whether the individual subcontracting reports from the prime contractors had been accepted by the government. The government uses individual subcontracting reports on eSRS as one

³²H.R. Rep. No. 112-479, at 284 (2012), accompanying Pub. L. No.112-239

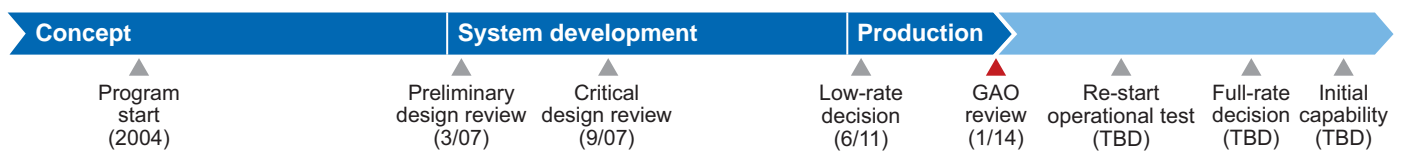
method of monitoring small business participation, as the report includes goals for small business subcontracting. Not all prime contracts for major defense acquisition programs are required to submit individual subcontracting reports. For example, some contractors report small business participation at a corporate level as opposed to a program level and this data is not captured in the individual subcontracting reports. Information gathered for this analysis is presented in appendix VI.

AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)

The AIM-9X Block II is a Navy-led program to acquire short-range air-to-air missiles for the F-35, the Navy's F-18, and the Air Force's F-15, F-16, and F-22A fighter aircraft. It is designed to detect, acquire, intercept and destroy a range of airborne threats. Block II includes hardware and software upgrades expected to improve the range from which the AIM-9X can engage targets, target discrimination, and interoperability. It was designated a major defense acquisition program in June 2011.



Source: U.S. Navy.



Program Essentials

Prime contractor: Raytheon Missile Systems
 Program office: Patuxent River, MD
 Funding needed to complete:
 R&D: \$113.2 million
 Procurement: \$4,167.0 million
 Total funding: \$4,280.2 million
 Procurement quantity: 5,321

Program Performance (fiscal year 2014 dollars in millions)

	As of 12/2011	Latest 09/2013	Percent change
Research and development cost	\$178.8	\$224.5	25.6
Procurement cost	\$4,023.0	\$3,568.0	-11.3
Total program cost	\$4,201.8	\$3,792.5	-9.7%
Program unit cost	\$0.700	\$0.632	-9.7%
Total quantities	6,000	6,000	0.0
Acquisition cycle time (months)	39	TBD	TBD

The AIM-9X Block II entered production in June 2011 with mature critical technologies, a stable design, and production processes that had been demonstrated on a production line, but were not in control. In July 2013, the Navy suspended operational testing for the AIM-9X Block II due to two issues with missile performance. According to the program office, one issue has been resolved with a software fix. However, the root cause for the second issue, related to probability of kill, a key performance requirement, was still under investigation during our review. The program has stopped accepting missiles until the root cause analysis is complete and the program determines what, if any, fixes to those missiles may be needed. The program also expects to delay the full-rate production decision from April 2014 until the second quarter of fiscal year 2015.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment
- Demonstrate all critical technologies in a realistic environment
- Complete preliminary design review

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

AIM-9X Block II Program

Technology and Design Maturity

The AIM-9X Block II entered operational testing with its critical technologies mature and its design stable. The Block II began as a pre-planned product improvement and various component development and integration efforts have been ongoing since 2004. According to the Navy's May 2011 technology readiness assessment, the Block II involves the integration of mature technologies, including a new active optical target detector/datalink, an upgraded electronics unit, and new operational flight software, among others. These hardware and software upgrades are intended to improve the missile's two-way communication capabilities, its tracking and targeting, its range, and its accuracy. The program estimates that 85 percent of Block II components are unchanged from Block I. In July 2013, the Navy suspended operational testing due to missile performance deficiencies. The root causes of the deficiencies are still under investigation.

Production Maturity

The AIM-9X Block II began production in June 2011 with manufacturing processes that had been demonstrated on a pilot production line, but were not in control. Prior to its production decision, the program concluded that its manufacturing readiness was at the level recommended by DOD guidance, but not at a level that indicated that processes were in control. According to the program office, a production readiness review and manufacturing readiness assessment will occur prior to the full-rate production decision, which has been delayed while the program corrects deficiencies discovered in operational testing. Officials expect that the missile's manufacturing processes will be in control prior to the full rate production decision. In the meantime, the AIM-9X prime contractor has met its internal quality goal for defects per unit, another indicator of production maturity, for the last several months of 2013.

Other Program Issues

The Navy suspended operational testing for the AIM-9X Block II in July 2013 after the program discovered multiple deficiencies that negatively affected missile performance. Officials report this will likely delay the full-rate production decision and initial operational capability to 2015. According to program officials, one of the two issues that led to

the suspension of testing related to the missile's target acquisition time, has been addressed through a software change. However, the root cause of the second issue related to its probability of kill—a key performance requirement—is still under investigation. Once the root cause is identified, the program will test the corrections in developmental testing before returning to operational testing. According to program officials, they have stopped accepting missiles from the contractor pending the results of the analysis, but production continues. According to program officials, the AIM-9X Block II program removed 14 missiles from its fiscal year 2013 procurement plans as a result of sequestration reductions. The AIM-9X program plans to pursue a material development decision to initiate a Block III acquisition program to further improve missile performance in 2014.

Program Office Comments

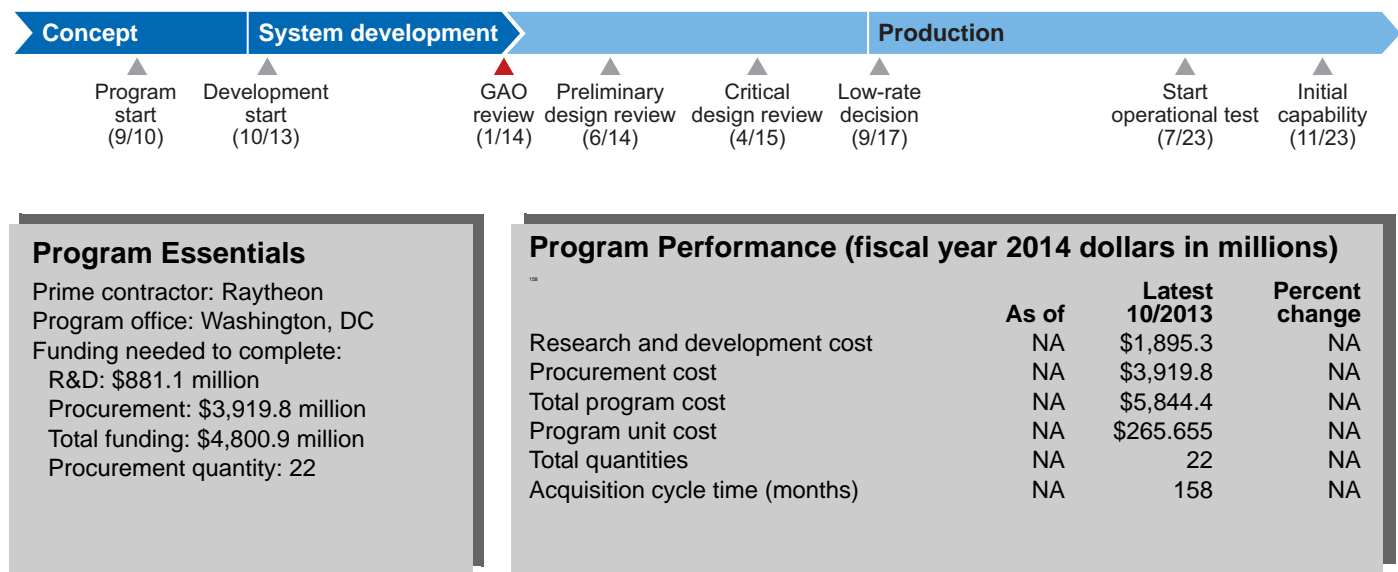
According to program officials, the AIM-9X Block II program is exceeding warfighters' expectations in every way, specifically, in the areas of cost, schedule and performance. The AIM-9X Block II program discovered deficiencies during operational testing and has implemented manufacturing and software improvements that meet or exceed requirements. The program remains on schedule to meet initial operational capability threshold and deliver "game changing capability" in the Beyond Visual Range Air-to-Air Missile employment.

Air and Missile Defense Radar (AMDR)

The Navy's Air and Missile Defense Radar (AMDR) will be a next-generation radar system designed to provide ballistic missile defense, air defense, and surface warfare capabilities. AMDR will consist of an S-band radar for ballistic missile defense and air defense, X-band radar for horizon search, and a radar suite controller that controls and integrates the two radars. AMDR will initially support DDG 51 Flight III. The Navy expects AMDR to provide the foundation for a scalable radar architecture that can be used to defeat advanced threats.



Source: U.S. Navy.



AMDR entered system development in October of 2013 with all four of its critical technologies approaching full maturity. This was 6 months later than planned, leading to a delay in many of the program's future events. These delays might impact the Navy's plan to design the DDG 51 Flight III, intended to carry the radar. The Navy and shipbuilders have determined that a 14-foot active radar is the largest that can be accommodated by the existing DDG 51 though AMDR is also being developed as a scalable design. A new X-Band portion will be developed under a separate program at a later date, with AMDR initially using a SPQ-9B radar in its place.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	○
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	■■■■ Information not available
○ Knowledge not attained	Not applicable

AMDR Program

Technology and Design Maturity

All four of the AMDR's critical technologies are approaching full maturity and were demonstrated using a 1000-element radar array. The array is a smaller version of the planned AMDR arrays. According to the program, two technologies previously identified as the most challenging—digital-beam-forming and transmit-receive modules, have been demonstrated in a relevant environment. Program officials stated digital-beam-forming is necessary for AMDR's simultaneous air and ballistic missile defense mission. The AMDR's transmit-receive modules—the individual radiating elements of the radar—use gallium nitride technology instead of the legacy gallium arsenide technology for potential efficiency gains. The other two critical technologies are related to software and digital receivers and exciters. Officials stated that software development will require a significant effort. A series of software builds are expected to deliver approximately 1 million lines of code and are designed to apply open system approaches to commercial, off-the-shelf hardware. Integrating the X-band radar will require further software development.

According to officials, much of AMDR's hardware has been demonstrated ahead of the preliminary design review, scheduled for June 2014, though the number of design drawings is still pending. The Navy obtained a waiver to hold this review after the start of system development citing cost concerns and a belief that the prototype array satisfactorily demonstrates AMDR's critical technologies.

Other Program Issues

AMDR entered system development in October of 2013—6 months later than planned, with corresponding delays to future program milestones. These delays might have an impact on the ability of the AMDR program to maintain its planned schedule for delivery in 2019. Additionally, the delays might also hinder timely delivery of necessary information related to AMDR's parameters, such as power, cooling, and space requirements needed for ongoing and planned design studies related to Flight III development. However, program officials do not anticipate a delay for AMDR's planned 2019 availability for integration into the first planned DDG 51 Flight III. The X-band

portion of AMDR will be comprised of an upgraded version of an existing rotating radar (SPQ-9B), instead of the new design initially planned. The new radar will instead be developed as a separate program at a later date and integrated with the thirteenth AMDR unit. According to the Navy, the upgraded SPQ-9B radar fits better within the Flight III's sea frame and expected power and cooling availability. Program officials state that the SPQ-9B radar will have capabilities equal to the new design for current anti-air warfare threats, it will not perform as well against future threats.

The Navy plans to install a 14-foot variant of AMDR on Flight III DDG 51s starting in 2019. According to draft AMDR documents, a 14-foot radar is needed to meet threshold requirements, but an over 20-foot radar is required to fully meet the Navy's desired integrated air and missile defense needs. However, the shipyards and the Navy have determined that a 14-foot active radar is the largest that can be accommodated within the existing DDG 51 deckhouse. Navy officials stated that AMDR is being developed as a scalable design but a new ship would be required to host a larger version of AMDR.

Program Office Comments

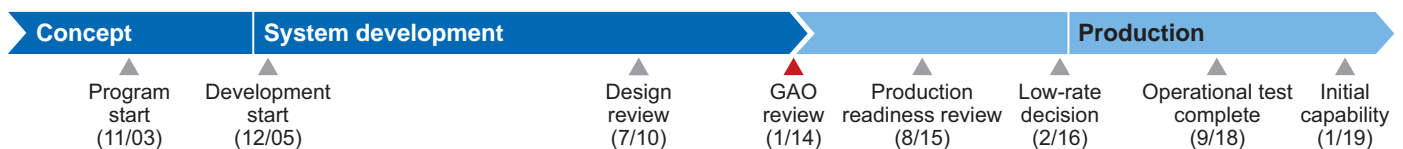
The program office concurred with this assessment and provided technical comments which were incorporated where appropriate.

CH-53K Heavy Lift Replacement Helicopter (CH-53K)

The Marine Corps' CH-53K heavy-lift helicopter is intended to transport armored vehicles, equipment, and personnel to support operations deep inland from a sea-based center of operations. The CH-53K is expected to replace the legacy CH-53E helicopter and provide increased range and payload, survivability and force protection, reliability and maintainability, and coordination with other assets, while reducing total ownership cost.



Source: 2013 Sikorsky Aircraft Corporation.



Program Essentials

Prime contractor: Sikorsky Aircraft Corporation
 Program office: Patuxent River, MD
 Funding needed to complete:
 R&D: \$2,258.5 million
 Procurement: \$18,366.2 million
 Total funding: \$20,668.6 million
 Procurement quantity: 194

Program Performance (fiscal year 2014 dollars in millions)

	As of 12/2005	Latest 08/2013	Percent change
Research and development cost	\$4,605.4	\$6,395.4	38.9
Procurement cost	\$12,808.2	\$18,366.2	43.4
Total program cost	\$17,413.6	\$24,805.5	42.4
Program unit cost	\$111.625	\$124.028	11.1
Total quantities	156	200	28.2
Acquisition cycle time (months)	119	157	31.9

The CH-53K program continues to move forward toward production, but has not yet fully matured its critical technologies or demonstrated that its design can perform as expected. As a result, the risk of design changes remains. According to program officials, the ground test vehicle has been delivered. However, a number of problems with producibility and qualification of parts have resulted in a delay in production of approximately 6 months and delays to qualification and flight testing.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ○

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained

○ Knowledge not attained

■■■■ Information not available

Not applicable

CH-53K Program

Technology Maturity

The CH-53K program began system development in 2005 with immature critical technologies. Nearly 9 years later the program's two critical technologies—the main rotor blade and main gearbox—are approaching maturity. The program expects these technologies to be demonstrated in a realistic environment by its planned February 2016 production decision, a delay in 6 months over last year's schedule. Program officials reported that they conducted a three-blade whirl test that produced results that exceeded required outcomes. Flight testing is expected to begin in late 2014.

Design Maturity

The CH-53K design appears stable, but it has not been demonstrated using a system-level prototype to show that it will perform as expected. The program has reported that they are relying on delivery of test vehicles to demonstrate their design. However, delivery of three of four of those test vehicles is projected to be delayed. Defense Contract Management Agency (DCMA) officials reported that the delays were caused by a number of factors such as late qualification testing, qualification test failures, re-testing, and the qualification of software. The delays have affected aircraft test schedules as well.

Production Maturity

Delivery of the ground test vehicle, which began production in July 2011, took place in October 2012. However, light off of the ground test vehicle—which will include testing of the main gear box and the rotor blades—was delayed until December 2013. Late component deliveries and parts shortages have delayed additional test aircraft deliveries. Test vehicle production is now approximately 10 months behind schedule, which has delayed the program's first test flight by approximately 4 months. These delays also resulted in a 6-month delay for the CH-53K's production decision, which has been moved to February 2016.

Other Program Issues

The CH-53K development contract was modified in April 2013 to reflect a new acquisition program baseline that reflects long standing increases in the program's cost and schedule. The program office reported that part of the increase to the

development contract was to include four system demonstration test articles. Program officials reported that in July 2011, the contract's estimated cost increased by \$724 million to \$3.4 billion. However, recent Defense Contract Management Agency independent cost estimates place the cost closer to \$3.7 billion, a total cost increase of approximately \$1 billion. The program's schedule contains concurrency between production and testing, which represents risk to the program and may require costly retrofits to aircraft after they have already been produced.

Program Office Comments

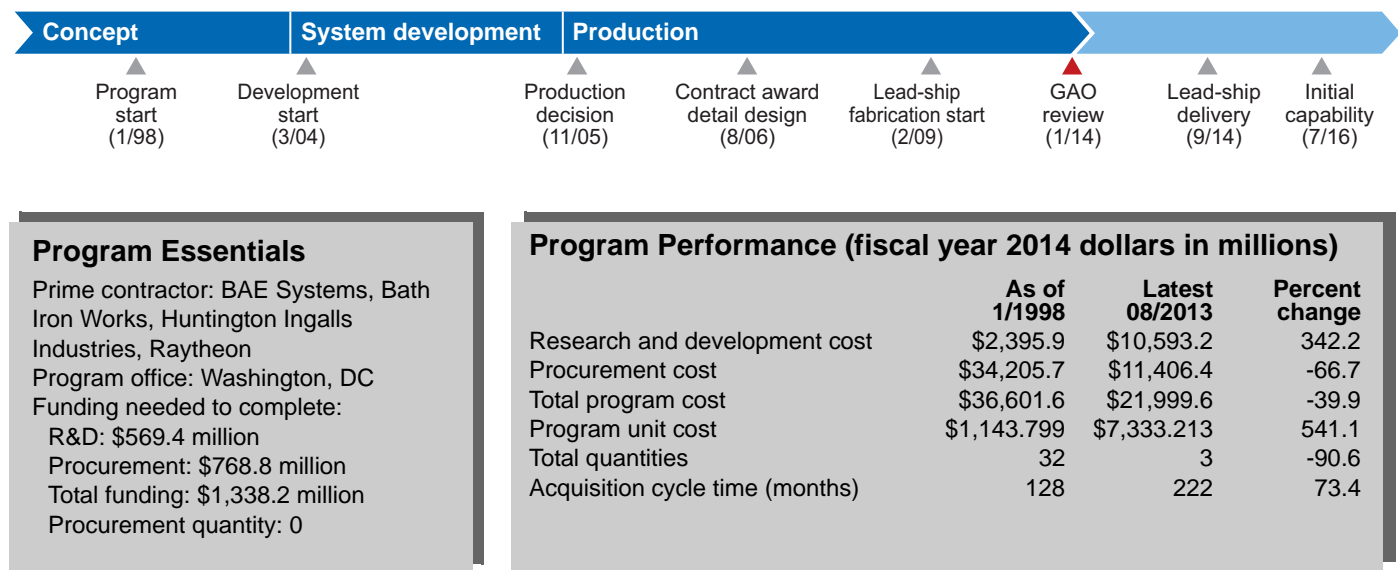
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated as appropriate.

DDG 1000 Zumwalt Class Destroyer (DDG 1000)

The Navy's DDG 1000 destroyer is a multimission surface ship designed to provide advanced capability for littoral operations and land-attack in support of forces ashore. The ship will feature a low radar profile and an advanced gun system. The lead ship was launched in October 2013 and the ship (comprised of the hull and mechanical and electrical systems) is currently scheduled for delivery in September 2014, with activation of the mission systems starting in 2015. Fabrication is underway on the remaining two ships in the class.



Source: © 2013 General Dynamics Bath Iron Works.



The DDG 1000 program has made progress in developing its critical technologies and the ship design is largely mature. While few design changes resulted from lead ship construction, the Navy decided to build the third ship's deckhouse and hangar with steel rather than composite materials due to manufacturing and integration challenges on the first two ships and as a long-term cost saving measure. The program is also incorporating technical configuration changes to maintain capability and minimize cost. Delivery of the lead ship (hull, mechanical and electrical systems) may slip past the currently scheduled date of September 2014 due to difficulties in completing the ship's electrical systems which is impacting test and activation events.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Complete three-dimensional product model	●
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

DDG 1000 Program

Technology Maturity

The DDG-1000 program has made progress in developing its critical technologies. However, only 3 of 11 are mature and the remaining 8 will not be demonstrated in a realistic environment until after installation on the lead ship. Guided flight tests of the gun system's long-range land-attack projectile were successfully completed in October 2013. After significant cost growth and development challenges, all six software releases for the total ship computing environment have been completed and certified to support lead ship activation and delivery and a software spiral update is under contract timed to support initial operating capability. Following a critical Nunn-McCurdy unit-cost breach in 2010, DOD restructured the program and removed the volume search radar from the ship's design. A modified multifunction radar is expected to begin land based testing in 2014, followed by at-sea testing in 2015.

Design and Production Maturity

The DDG 1000 design is largely mature. According to the program manager and ship builder, as of October 2013, production and test efforts for the first two ships were 88 and 70 percent complete, respectively. While few design changes have resulted from lead ship construction, shipbuilders have experienced challenges with the manufacture and integration of the composite deckhouse for the first and second ships, resulting in rework and schedule delays particularly on the first ship. The Navy has emphasized a joint inspection process whereby the prime contractors and the Navy validate product quality and completeness prior to integration with the hull. After assessing alternatives and conducting a competition, the Navy decided to build the third ship's deckhouse and hangar with steel as a cost saving measure as the program manager noted that the Navy has better cost insights into the long-term maintenance of steel compared to composite materials.

Other Program Issues

Delivery of the lead ship (hull, mechanical and electrical systems) may slip past the currently scheduled date of September 2014 and the Navy is in the process of assessing the delivery date. If delivery slips past October 2014, the program will breach its acquisition program baseline schedule

requirements. According to the Navy, the delay is the result of difficulties in completing the ship's electrical systems, which is impacting test and activation events.

The program has awarded all major contracts for the three ships in the DDG 1000 class among four prime contractors. As the integrator, the Navy is responsible for ensuring on-time delivery of products and bears the costs of schedule delays that affect another contractor. Bath Iron Works is now producing the hull for all three ships. In August 2013, the Navy awarded a fixed price contract to Bath Iron Works for a steel deckhouse, hangar, and aft peripheral vertical launching system for the third ship. According to the program manager, the shipbuilder negotiated a 5- and 10-month delivery delay for the second and third ship, respectively.

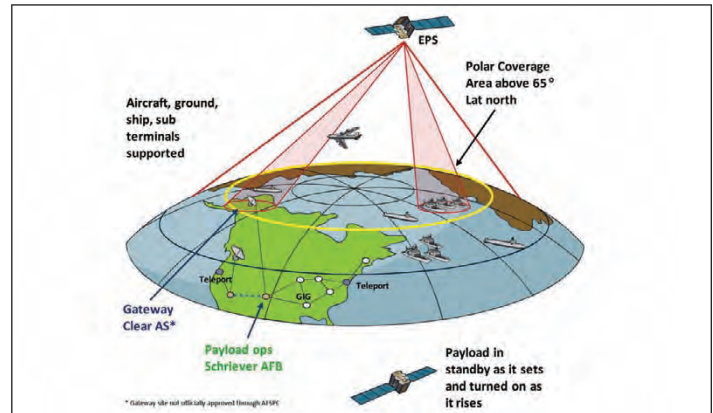
Program officials also reported that the program absorbed sequestration reductions of \$70 million in fiscal year 2013 by delaying testing and the award of contracts for mission-related equipment. The program is also incorporating technical configuration changes resulting from the configuration steering board and Nunn-McCurdy annual cost review aimed at maintaining capability and minimizing costs. For example, the program manager told us the program assessed alternatives to the close in gun system and chose a legacy system that met requirements with about half the weight and cost.

Program Office Comments

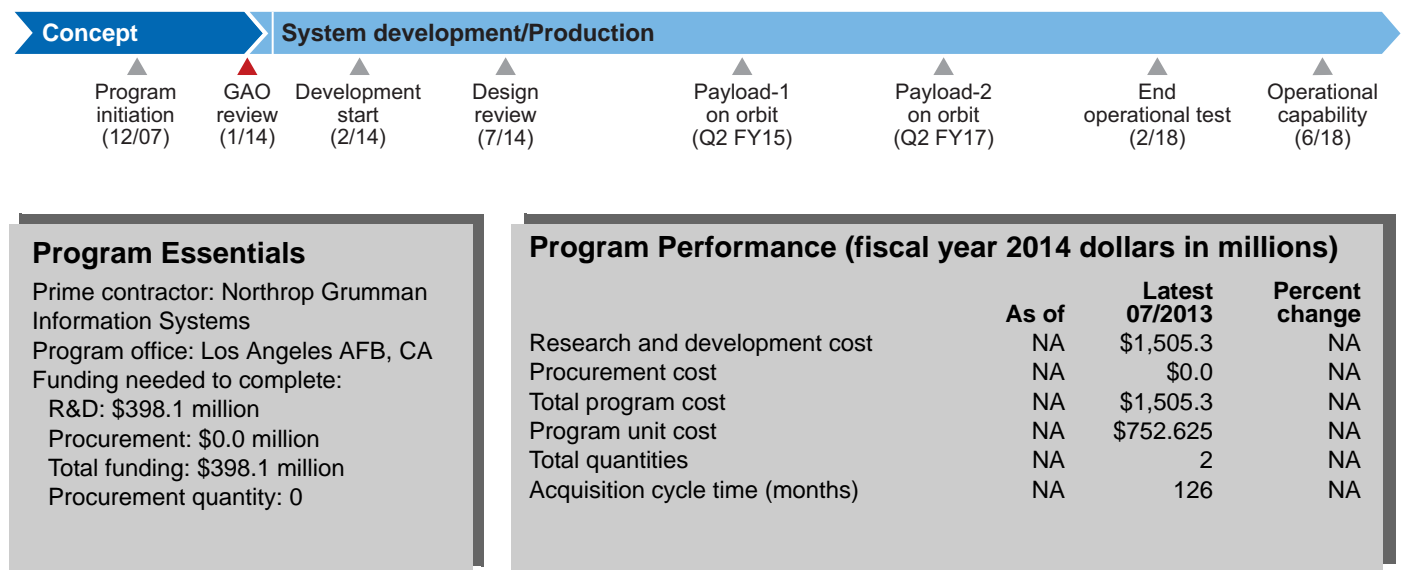
In commenting on a draft of this assessment the Navy noted that the DDG 1000 lead ship was successfully launched in October 2013, a christening is scheduled for April 2014, and activation activities continue. For the second ship, keel laying and hangar erection have occurred, hull integration is underway, and deckhouse delivery is scheduled for spring 2014. The Navy noted that significant integration efforts between four prime contractors continue with a focus on cost reduction and schedule performance. The Navy also provided technical comments, which were incorporated where deemed appropriate.

Enhanced Polar System (EPS)

The Air Force's Enhanced Polar System (EPS) is to provide next-generation protected extremely high frequency (EHF) satellite communications in the polar region. It will replace the current Interim Polar System and serve as a polar adjunct to the Advanced EHF (AEHF) system. EPS is to consist of two EHF payloads hosted on classified satellites, a gateway to connect modified Navy Multiband Terminals to other communication systems, and a control and planning segment (CAPS).



Source: LinQuest Corporation.



The three segments of the EPS are in various stages of development. Although the EPS program's two payloads are built, funding constraints resulted in reductions to the requirements of the control and planning segment and gateway segment, which delayed initial operational capability by 2 years. However, the reduction of capabilities also reduced the amount of development necessary and allowed for a revised acquisition strategy that, according to the program office, reduced risk and cost.

Attainment of Product Knowledge	
Projected as of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

EPS Program

Technology and Design Maturity

EPS was initiated in 2007 to fill a gap identified in the Advanced Polar System study. The Under Secretary of Defense for Acquisition, Technology, and Logistics directed the program to proceed to system development to synchronize the program's payload schedule with the host satellite's production timeline. The host program awarded the payload development contract in July 2008, following an acquisition board equivalent to a system development decision. Payload development proceeded and all six critical technologies are fully mature, according to the program office. Both payloads are built and the first payload is fully integrated into the host satellite, which is currently undergoing system-level testing.

In contrast, the control and planning segment (CAPS) and gateway development was delayed. Because of funding constraints, the program office used a design-to-cost approach to reduce CAPS and gateway development to the minimum capability needed. The revised EPS acquisition strategy incorporating changes to CAPS and gateway development was approved in January 2012. The CAPS design contract was awarded in December 2012, with a planned system development decision in July 2014. The gateway requires integration of existing commercial off-the-shelf and government furnished equipment and is considered low risk by the program office.

Other Program Issues

The reduction in capabilities for the CAPS and gateway allowed a change in acquisition strategy that reduced cost and risk but also delayed operational capability from fiscal year 2016 to 2018. Under the original acquisition strategy, CAPS was planned as a follow-on increment to the AEHF mission control segment. A sole source award was to be made to AEHF's prime contractor for CAPS, while the gateway was to be competitively awarded. The reduced requirements and revised acquisition strategy allowed for CAPS to be competitively awarded. The reduction of requirements nearly eliminated the development work for the gateway. Consequently, the Navy's Space and Naval Warfare Systems Command (SPAWAR) System Center Pacific will be responsible for integrating, testing, installing, certifying, and sustaining the gateway

segment. According to the program office, this approach also reduces cost and schedule as it would take time for a contractor to develop the expertise and test beds that SPAWAR System Center Pacific already has. The reduction in requirements and revised acquisition strategy reduced overall program cost by about \$1 billion, according to program officials.

The payloads are expected to be on orbit in fiscal years 2015 and 2017 respectively. By the current schedule, CAPS site installation will occur in late fiscal year 2016. According to the program office, CAPS is not required for payload on-orbit testing, but it is required for inter-segment testing scheduled for the first quarter of fiscal year 2017 and for overall functioning of the EPS system. There is adequate schedule margin according to officials, but any additional delays such as delayed funding or program milestones will result in a further delay in operational capability.

Program Office Comments

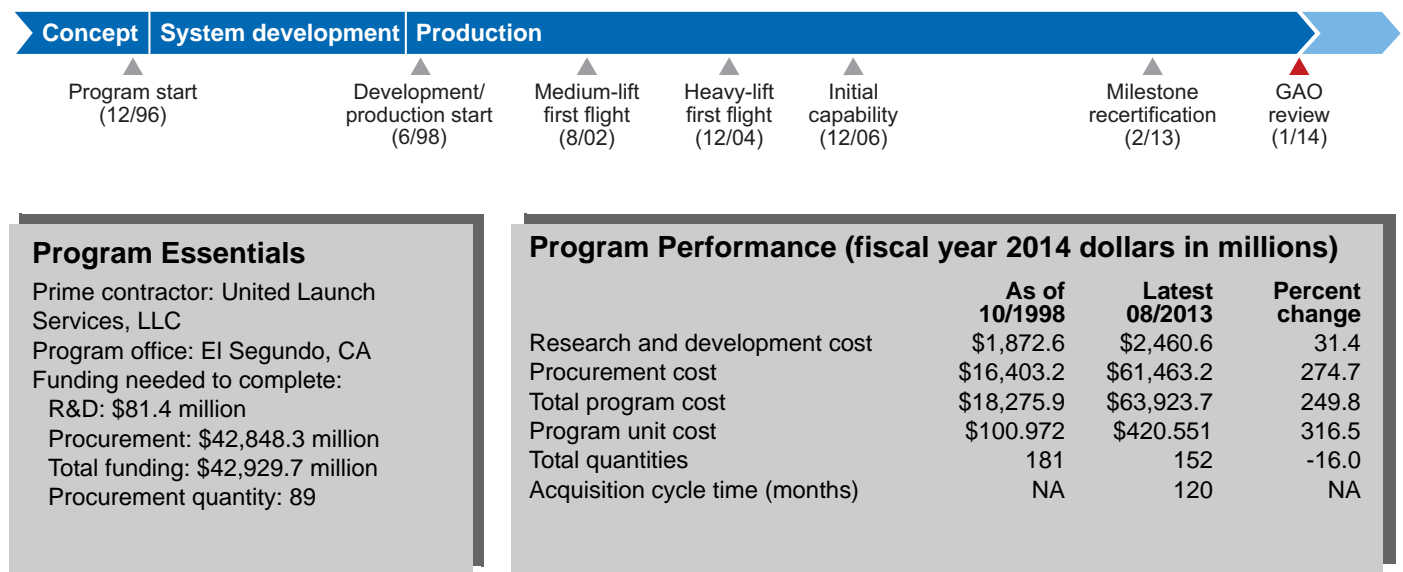
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Evolved Expendable Launch Vehicle (EELV)

The Air Force's EELV program acquires launch services to provide critical space support to DOD, national security, and other government missions. The United Launch Alliance is currently the sole provider of launch vehicles for U.S. military and intelligence satellites. However, the Air Force may certify new launch providers to compete for future launch services. Today, the program consists of two families of launch vehicles, support systems, and launch site operations. We assessed the Atlas V and the Delta IV.



Source: © 2012 United Launch Alliance.



We assessed EELV technology as mature with 66 successful launches as of December 2013. We could not assess design or production maturity using our best practices. All of the 14 EELV launch vehicle variants have launched at least once. However, only three variants—the Atlas V 401, the Delta IV Medium, and the Delta IV Heavy—have launched seven times, proving production maturity according to an Aerospace Corporation measure developed for the program. EELV completed recertification after reporting Nunn-McCurdy critical unit cost breaches in the March 2012 Selected Acquisition Report and transitioned back into the production phase in February 2013. The program is estimated to cost over \$70 billion through 2030. EELV program officials are currently conducting activities to certify new launch providers and signed a contract modification to procure additional EELV launches.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

EELV Program

Technology, Design, and Production Maturity

While EELV's technology is mature, we could not assess design and production maturity because the Air Force does not obtain information from the contractor that would facilitate this assessment. According to the Aerospace Corporation's measurement known as the "3/7 reliability rule," once a vehicle variant is launched successfully three times its design can be considered mature. Similarly, if a vehicle is successfully launched seven times, both the design and production process can be considered mature. Based on this rule, few variants have reached maturity for both design and production. Each of the 9 Atlas V variants and the five Delta IV variants has flown at least once, demonstrating the viability of their technologies, and 10 of the Atlas and Delta variants have flown three times, demonstrating design maturity according to Aerospace's rule. However, only 3 of the 14 EELV variants have demonstrated production maturity with seven flights. Until a launch vehicle configuration demonstrates design and production maturity, problems with fleetwide designs or production processes may go undiscovered, which could cause significant cost and schedule risk.

The Air Force is investigating the root cause of an anomaly with the Delta IV upper stage engine which did not perform as expected during a launch in October 2012. According to the EELV program office, the initial phase of the investigation was completed in May 2013 but a root cause determination was not made. While the engine has performed normally on launches in May and August 2013, the Air Force delayed a third launch of the Delta IV scheduled for October 2013, due to new conclusions from the investigation and to fully understand the anomaly and reduce any potential risks.

Other Program Issues

Due to a program restructuring stemming from the Nunn-McCurdy breaches reported in the March 2012 Selected Acquisition Report, the program developed a new acquisition program baseline, which was approved in early 2013. The estimated costs for the program are about \$70 billion based on the need for 151 launches through the year 2030. This estimate is around \$35.7 billion more than the previous estimate reported in March 2012. The

program identified several causes for this cost growth including extension of the program life-cycle from 2020 to 2030, procurement of 60 additional launch vehicles, the inherently unstable nature of the demand for launch services, and industrial base instability.

The Air Force signed a contract modification in December 2013 to procure additional EELV launches and has revised its acquisition strategy to meet some of DOD's EELV-class launch vehicle needs. EELV-class is defined as a vehicle or family of vehicles that can reliably launch a variety of payloads up to 13,500 pounds to geosynchronous earth orbit. The revised strategy outlines how to certify a new provider's launch vehicle based on risk classifications for individual payloads. After a new provider completes its first successful flight, the Air Force will award early integration study contracts for the payloads the vehicle is projected to be capable of launching. In November 2012, the Air Force awarded an EELV-class launch service contract to Space Exploration Technologies (SpaceX), in an effort to support the demonstration of its capabilities as part of the certification process. In September and December 2013, SpaceX launched its first and second vehicles toward certification respectively.

Program Office Comments

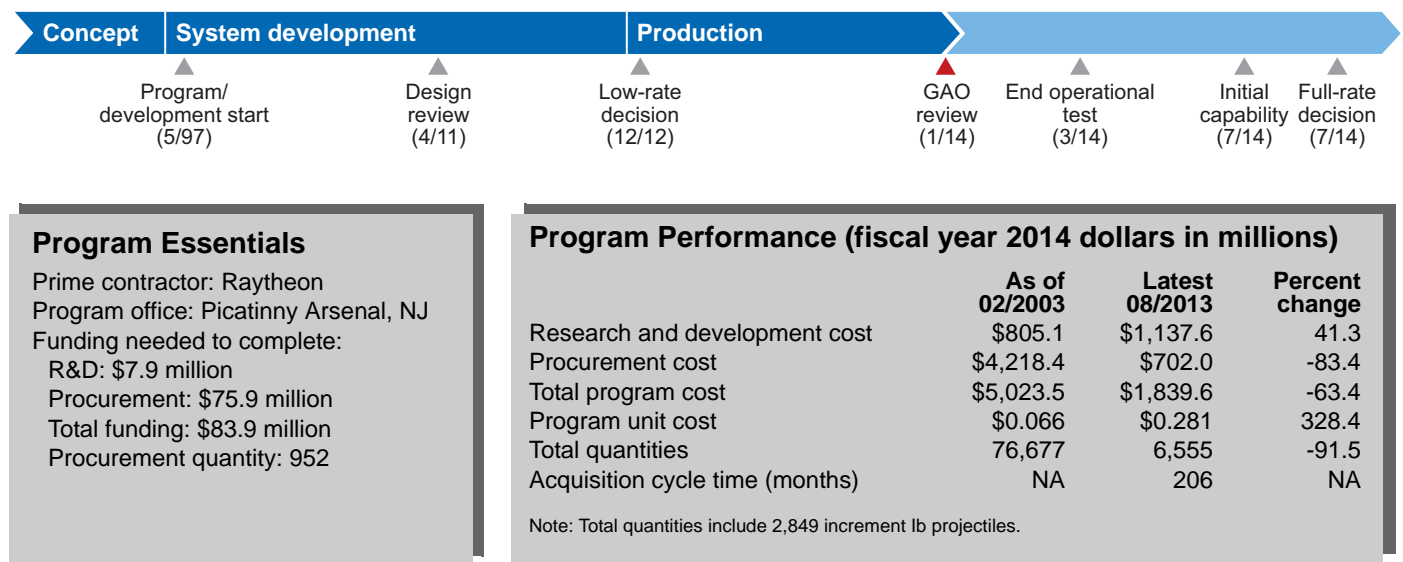
The Air Force provided technical comments, which were incorporated as appropriate.

Excalibur Precision 155mm Projectiles (Excalibur)

The Army's Excalibur is a family of global positioning system-based, fire-and-forget, 155mm cannon artillery precision munitions intended to provide improved range and accuracy. The near-vertical angle of fall is expected to reduce collateral damage, making it more effective in urban environments. The Army is using an incremental approach to deliver capabilities. Increment Ia-1 is fielded, Ia-2 is in production, and Ib, which is expected to increase reliability and lower unit costs, began production in 2012. We assessed increment Ib.



Source: U.S. Army.



The Excalibur program has made multiple design changes to address reliability concerns since 2012, including a risk that it may not meet its reliability threshold requirement. The Ib round still does not meet insensitive munitions requirements. According to program officials, however, it does meet military standards and the program has projected test dates to address concerns of the Army Insensitive Munitions Board. The program reduced the number of rounds planned for procurement due to a recommendation in the conference report accompanying the Consolidated and Further Continuing Appropriations Act, 2013 and sequestration but has requested restitution of those funds in fiscal years 2015 and 2016.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	Information not available
○ Knowledge not attained	Not applicable

Excalibur Program

Technology and Design Maturity

The Excalibur program's critical technology is fully mature. The program has made multiple incremental design changes intended to increase reliability since the low-rate production decision in 2012. For example, the contractor producing the Global Positioning System (GPS) receiver made hardware and software changes to increase receiver reliability in the gun launch environment. Additionally, the program has made changes to the guidance assembly and the fuze safe and arm device to address failures during 1b round developmental testing. There have been no design changes to the warhead or the operational flight software. The 1b round still does not meet requirements related to insensitive munitions—ensuring that a round will not detonate under any condition other than its intended mission. According to program officials, however, it does meet military standards. The program reports that a follow-up test to meet the Army Insensitive Munitions Board requirements, which was delayed due to sequestration and furloughs during the government shutdown, is projected for early 2014. Ensuring compliance with this requirement could require design changes and the program is uncertain of the total number of drawings that will ultimately be required.

The program reported that it received a funding increase in fiscal year 2014 of \$5 million to support the completion of initial operational test and evaluation, which was subsequently reduced due to sequestration for a net increase of \$4.3 million. All performance and safety requirements have been met, but reliability testing will not be complete until after production has begun.

Production Maturity

According to program officials, the program is at low risk of not meeting its reliability threshold of 90 percent and at moderate-to-high risk of not meeting its reliability objective. However, given test results since the low-rate decision, the program expects to meet the threshold reliability requirement. The program has been authorized to procure 1800 rounds in low-rate production and will seek authorization to procure the remaining rounds at the full-rate production decision, tentatively scheduled for mid-2014.

Other Program Issues

The program is still projecting to produce 3,455 1b rounds, but its fiscal year 2013 procurement funding was cut by \$47.5 million due to a recommendation in the conference report accompanying the Consolidated and Further Continuing Appropriations Act, 2013 and sequestration. As a result the program is reporting a 17 percent reduction of rounds for procurement. The program, however, has requested restoration of funding for those rounds in fiscal years 2015 and 2016. The project originally planned for funding to end in fiscal year 2014; spreading funding into future years will increase the life of the program and may have additional costs.

Program Office Comments

In commenting on a draft of this assessment, program officials stated that Excalibur continues to provide commanders with an organic precision targeting capability resulting in over 700 rounds being fired in combat to date. They also stated that the program continues to execute within all acquisition program baseline parameters and is meeting or exceeding all five of its key performance parameters. Excalibur Increment 1b has shown performance improvements and continues to execute to the plan approved by both the Army and joint insensitive munitions board and has seen improvements in the area of less sensitive reactions.

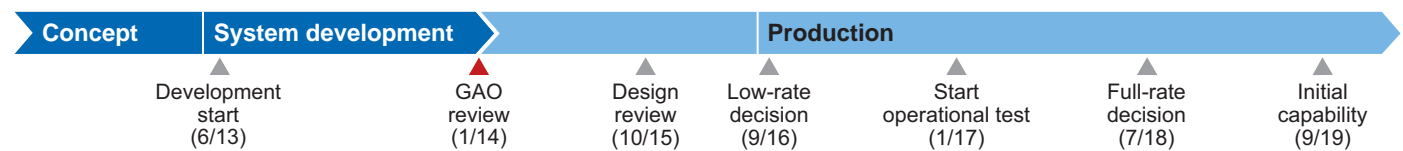
Program officials stated that the final Excalibur increment began low-rate initial production in first quarter fiscal year 2014 and successfully completed first article testing in December 2013. The current Excalibur production contract contains fixed price procurement options to ensure consistent procurement costs through fiscal year 2016. The program also provided technical comments, which were incorporated as appropriate.

F-22 Increment 3.2B

The Air Force's F-22 Raptor is a stealthy air-to-air and air-to-ground fighter/attack aircraft. The Air Force established an F-22 modernization and improvement program in 2003 to add enhanced air-to-ground, information warfare, reconnaissance, and other capabilities and to improve the reliability and maintainability of the aircraft. Increment 3.2B, the fourth increment of the modernization program, was initially managed as part of the F-22 baseline program, but is now being managed as a separate major defense acquisition program.



Source: U.S. Air Force.



Program Essentials

Prime contractor: Lockheed Martin
 Program office: Wright-Patterson AFB, OH
 Funding needed to complete:
 R&D: \$543.1 million
 Procurement: \$339.1 million
 Total funding: \$882.2 million
 Procurement quantity: 143

Program Performance (fiscal year 2014 dollars in millions)

	As of 06/2013	Latest 09/2013	Percent change
Research and development cost	\$1,222.1	\$1,218.8	-0.3
Procurement cost	\$344.6	\$339.1	-1.6
Total program cost	\$1,566.7	\$1,557.9	-0.6
Program unit cost	\$10.308	\$10.249	-0.6
Total quantities	152	152	0.0
Acquisition cycle time (months)	72	75	4.2

Increment 3.2B is an enhancement to the F-22, bringing upgraded electronic protection, geolocation, and intra-flight data link capabilities, and integrating AIM-9X and AIM-120D missiles. The Air Force received approval to begin system development of Increment 3.2B as a separate major defense acquisition program in June 2013. The one reported critical technology has been demonstrated in a relevant, but not a realistic, environment. Full maturity is expected by the critical design review in October 2015, by which point the Air Force also anticipates achieving full design stability. There may be a production gap of two to four years between qualification of hardware for the program and the beginning of low-rate initial production. The program office stated that it has mitigated risk related to AIM-9X software development.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

F-22 Inc 3.2B Program

Technology and Design Maturity

Increment 3.2B's sole, identified critical technology, a geolocation algorithm, is not yet fully mature having been demonstrated only in a relevant environment. The program office expects the technology to reach full maturity by October 2015. The Air Force also anticipates achieving full design stability by the October 2015 critical design review as 92 percent of system level drawings are currently releasable. A knowledge-based acquisition approach is a cumulative process, and mature technology is a prerequisite for moving into system development. The program intends to demonstrate that the design can perform as expected by integrating and testing all key subsystems and components prior to the critical design review.

Production Maturity

Prior to system development, DOD systems engineering personnel identified a production gap of two to four years between qualification of hardware for Increment 3.2B and the beginning of low-rate initial production as a risk as some of the electronic components used may no longer be available when production begins. The program office stated that it is working closely with suppliers to mitigate identified risks through an advance procurement contract. Program officials partly attributed the gap to an early start made on hardware development given initial assumptions about the amount of development involved. Additionally, the Defense Contract Management Agency has noted supplier developmental issues with displays and processing modules which support Increment 3.2B.

Other Program Issues

Consistent with direction from Congress and the Office of the Secretary of Defense, the Air Force designated F-22 Increment 3.2B as a distinct major defense acquisition program rather than managing it as part of the F-22 baseline program. About half of the program's \$1.2 billion estimated development cost was spent under the F-22 baseline program. Originally scheduled for December 2012, the approval to formally initiate the Increment 3.2B acquisition program and begin system development was delayed until June 2013 as it took longer than expected to prepare Air Force and independent cost estimates. According to cost estimators, the delay is attributable to their having to reconstruct missing

cost information from prior modernization increments in order to estimate costs for Increment 3.2B.

An initial risk assessment noted that if the Increment 3.2B program did not receive the customized software that allows the F-22 to use the AIM-9X air-to-air missile in time for operational testing, it might face a delay in its overall fielding schedule. The F-22 program office stated that it has mitigated risk related to missile software development, and has signed an agreement with the AIM-9X program office on technical and schedule requirements for integrating the missile. The F-22 program office plans to field limited AIM-9X capabilities prior to the completion of Increment 3.2B by including them as part of an earlier software update.

Program Office Comments

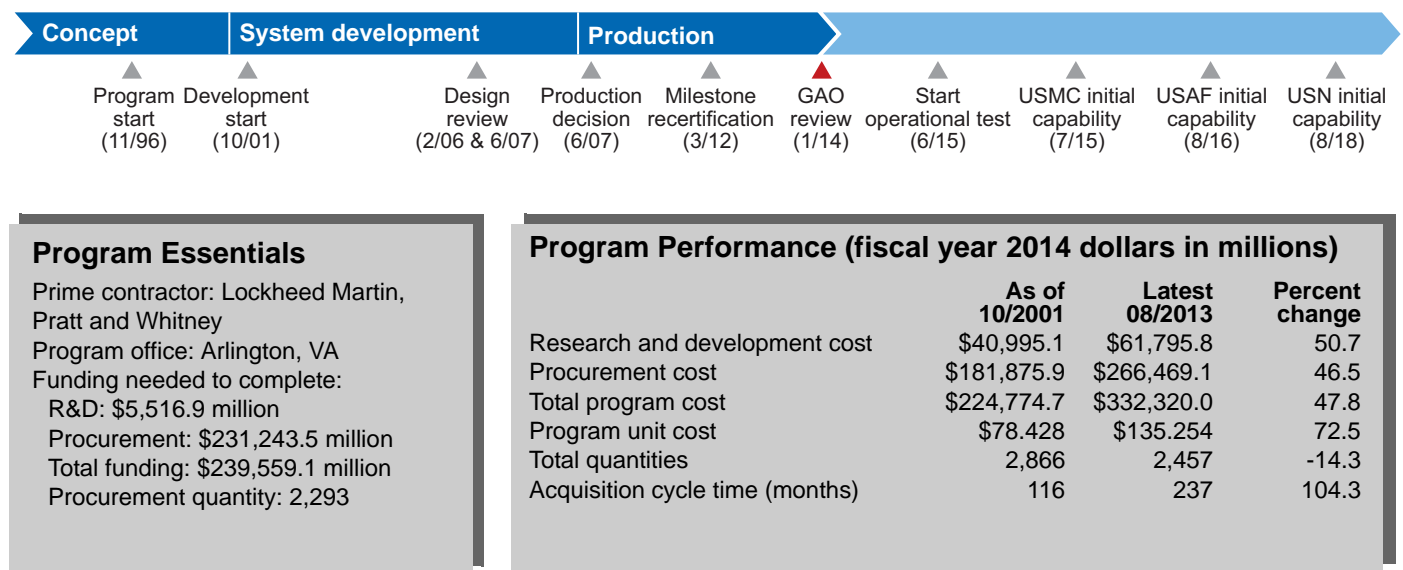
The Air Force provided technical comments, which were incorporated as appropriate.

F-35 Lightning II Program (F-35)

DOD's F-35 program is developing a family of stealthy, strike fighter aircraft for the Navy, Air Force, Marine Corps, and U.S. allies, with the goal of maximizing commonality to minimize life-cycle costs. The carrier-suitable variant will complement the Navy F/A-18E/F. The Air Force variant is expected to replace the air-to-ground attack capabilities of the F-16 and A-10, and complement the F-22A. The short take-off and vertical landing (STOVL) variant is expected to replace the Marine Corps F/A-18 and AV-8B aircraft.



Source: Courtesy of Lockheed Martin.



Although the F-35 program has invested billions of dollars and ordered 150 production aircraft, gaps in product knowledge persist. Four critical technologies are not mature and the program continues to experience design changes. Development testing is progressing but is far from complete and will likely drive more changes in design and manufacturing processes. While manufacturing efforts are improving, only twenty-five percent of the program's critical manufacturing processes are mature and capable of consistently producing quality parts, and fewer planes were produced in 2013 than initially planned. Software development has progressed; but if additional delays are encountered initial operating capability dates could be at risk. Long-term affordability and sustainment costs remain challenging.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	○
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

F-35 Program

Technology Maturity

Three of the program's critical technologies are nearing maturity while one is immature. The program has made progress addressing technical risks including the helmet mounted display, which is needed for the aircraft to fully perform its missions, and the Autonomic Logistics Information System (ALIS), which is critical to the operations and sustainment of the fleet. The program recently chose to end development of an alternate helmet due to progress made on the original helmet design and work on development of a newer generation helmet. ALIS integration and testing continues with the next, more capable version expected to be delivered in 2014.

Design Maturity

Although the three aircraft designs were not stable at critical design reviews in 2006 and 2007, all expected engineering drawings have since been released. However, issues discovered in testing continue to drive design changes. In 2013, bulkhead and rib cracks were discovered in the STOVL variant that may require the program to make changes to production and retrofit aircraft. The carrier variant's new arresting hook system successfully completed a critical design review and is expected to be ready for carrier use by October 2014. With significant testing remaining, additional design changes are likely.

Production Maturity

DOD has invested about \$35 billion in procuring 150 aircraft through 2013. The contractor uses statistical process controls as one means to assess critical manufacturing processes. Twenty five percent of those processes are currently judged capable of consistently producing quality parts at the best practice standards. Production efforts have improved as the production line continues to show efficiencies and quality metrics show positive trends. However, in 2013, problems with engine hoses, engine turbines, and specialty metals halted production deliveries for three months. In 2013, 35 planes were delivered to the government—eight less than originally planned. Aircraft deliveries were postponed for one month while the runway at the final assembly facility was resurfaced.

Other Program Issues

In 2013, the military services re-established initial operating capability dates for their respective F-35 variants. To achieve those dates, the Marine Corps and Air Force will accept basic warfighting capabilities provided by software Blocks 2B and 3I respectively, while the Navy intends to wait for the full suite of capabilities provided by software Block 3F. Block 2B development is currently behind schedule, which could impact the development of Block 3I, and subsequently 3F. Any additional software delays could put initial operating capability dates at risk as software is essential to achieve aircraft capabilities such as sensor fusion, weapons and fire control, maintenance diagnostics, and propulsion. In addition, the program's long-term affordability remains a challenge. The amount of annual funding required to complete development and procurement of the F-35 is more than \$12 billion on average, while the cost to operate and support the aircraft is estimated at more than \$1 trillion over its life-cycle. These estimates may change over time as testing progresses and more concrete information becomes available.

Program Office Comments

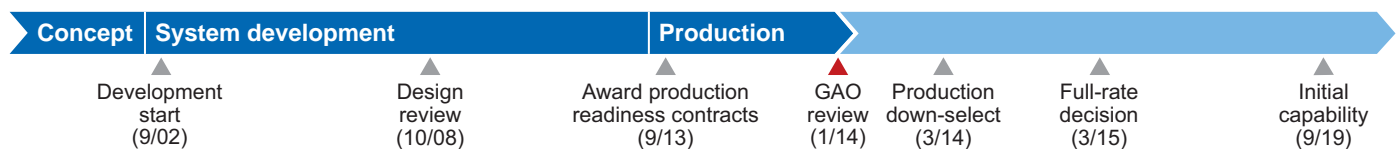
In addition to providing technical comments, the program noted that it appreciates GAO's reviews in assisting the program by identifying areas for improvement. The program has made great strides in the past year to further stabilize technology, design, and production maturity, and work continues on identified areas to improve program performance. The program ended development of the alternate F-35 helmet as further testing indicated it is acceptable for USMC initial operating capability. Continued improvements will be made in the Gen III helmet. This decision includes a guarantee from industry to reduce the unit cost by 12 percent from previous estimates. Aircraft and engine quality continues to improve as manufacturing processes mature, and unit costs continue to come down lot over lot. The program has taken steps to improve management of concurrency risk and minimize costs to the services by reducing the time required to implement changes into the production line so that fewer aircraft need post-production retrofits.

Family of Beyond Line-of-Sight - Terminals (FAB-T)

The Air Force's FAB-T program plans to provide a family of satellite communications terminals for airborne and ground-based users to replace many program-unique terminals. It is being designed to work with current and future communications capabilities and technologies. FAB-T is expected to provide voice and data over military satellite communications for nuclear and conventional forces through ground command posts and E-6 and E-4 aircraft, and was originally planned to provide force element capabilities on B-2, B-52, and RC-135 aircraft.



Source: U.S. Air Force.



Program Essentials

Prime contractor: Boeing, Raytheon
 Program office: Bedford, MA
 Funding needed to complete:
 R&D: \$196.0 million
 Procurement: \$2,190.6 million
 Total funding: \$2,386.6 million
 Procurement quantity: 216

Program Performance (fiscal year 2014 dollars in millions)

	As of 12/2006	Latest 10/2013	Percent change
Research and development cost	\$1,616.7	\$2,406.0	48.8
Procurement cost	\$1,736.9	\$2,212.0	27.4
Total program cost	\$3,353.6	\$4,618.0	37.7
Program unit cost	\$15.526	\$18.772	20.9
Total quantities	216	246	13.9
Acquisition cycle time (months)	129	204	58.1

The latest cost data do not reflect the current cost of the program and the latest quantities do not reflect recent program decisions. A new acquisition program baseline has not yet been approved.

The program is approaching a production decision with a stable, demonstrated design but without having conducted key assessments. Due to continued cost and schedule growth in developing this design, the Air Force signed a development contract with an additional vendor in September 2012 to establish an alternate source for a system with capabilities similar to the original vendor's FAB-T effort. An acquisition baseline updated to reflect the award to a second vendor, and other changes to the program strategy since 2010, has been delayed and will not be approved until after the Air Force determines which vendor will move forward into production. Despite numerous changes to the program, an independent cost estimate has not been conducted since 2009, but is expected in early 2014.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment
- Demonstrate all critical technologies in a realistic environment
- Complete preliminary design review

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

FAB-T Program

Technology Maturity

According to the program office, all of the critical technologies for both vendors are fully mature based on the vendors' self-assessments. The program does not currently plan to conduct an independent technology readiness assessment for the alternate vendor. The program office also stated that both vendors have functional prototypes being utilized for testing.

Design Maturity

According to the program office, FAB-T's design is stable for both the original and alternate vendor development programs. The original vendor completed functional qualification testing in August 2013. The alternate vendor completed a system-level design review in June 2013 and demonstrated a system-level integrated prototype in October 2013.

Production Maturity

In 2012, FAB-T's acquisition strategy was changed to initiate two possible production paths: one providing both command and force element terminals, and the other only command terminals. Both vendors submitted proposals to compete for both approaches. In December 2013, the Air Force chose to pursue the command terminal only approach and the program plans to make a down-select decision to one vendor in the second quarter of fiscal year 2014. Depending on which vendor is chosen, the low-rate production decision is planned for either March 2014 or September 2014.

A 2012 acquisition decision memorandum called for several steps before the award of FAB-T's production contracts, including: an independent cost estimate; a revised acquisition program baseline; and a defense acquisition board review. Program officials stated that neither the cost estimate nor the revised baseline will be completed prior to the down-select decision. Department officials stated that the review has been delayed and not yet rescheduled. Also, FAB-T does not plan to independently assess manufacturing readiness levels prior to the down-select decision. Air Force decisions to commit to a production contractor before the program is fully assessed introduce additional acquisition risk.

Other Program Issues

In October 2010, an independent review team noted that the program was likely in breach of critical Nunn-McCurdy unit cost thresholds but a breach has not yet been reported by the program. In 2012, the FAB-T program made several revisions to its acquisition strategy—including modification of the original development contract from cost plus award fee to firm fixed-price and the addition of competition by awarding the alternate vendor contract in response to these concerns about cost growth. However, a new acquisition program baseline and independent cost estimate that reflect these changes and their projected costs will not be completed until 2014.

According to Department officials, the requirement for the force element terminals remains in the program but is not currently funded. If not integrated with the B-2 and B-52 bomber platforms, FAB-T may not meet its full range of planned communications capabilities as some are based on the interaction of bomber aircraft with intelligence, surveillance, and reconnaissance aircraft and command terminals.

Program Office Comments

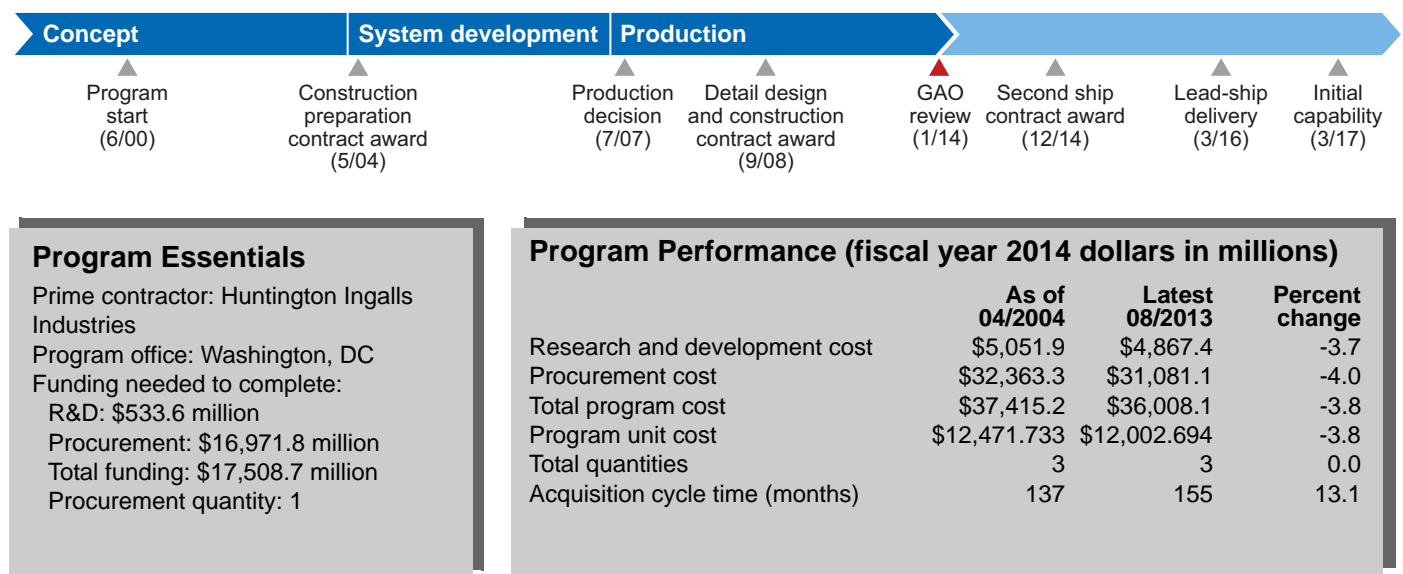
According to program officials, the FAB-T program office continued to execute the revised acquisition strategy in 2013. Significant progress was made by both contractors on their respective development contracts. With respect to production efforts, production planning contracts were awarded to lock down prices. In addition, the competition for command terminals is on-going, and the Air Force has scheduled a down select decision in the second quarter of fiscal year 2014. The independent cost estimate and acquisition program baseline will then be updated to re-baseline the program. To address the cost thresholds and breach concerns, program officials said they are confident that adequate technology and manufacturing assessments, along with the revised cost and schedule evaluation, will be conducted prior to the decision to exercise the first production option. The program office's assessment is that there will be a stable and mature design, with a reliable manufacturing process, to proceed into operational unit production for this critical operational capability.

Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78)

The Navy's CVN 78 class of nuclear-powered aircraft carriers is designed to improve operational efficiency, enable higher sortie rates, and reduce manpower through the use of advanced propulsion, aircraft launch and recovery, and survivability technologies. The lead ship, CVN 78, was 70 percent complete at launch; however, its delivery is delayed until March 2016. Also, contract negotiations prompted the Navy to defer the construction contract for CVN 79 until early fiscal year 2015.



Source: U.S. Navy.



The Navy awarded a construction contract for CVN 78 in September 2008 when only 5 of the ship's 13 current critical technologies were mature and the ship's three-dimensional (3D) product model was incomplete. Since then, the lead ship's procurement costs have grown by over 22 percent, from \$10.5 billion to \$12.8 billion. At present, 7 of the currently planned technologies are mature, with the rest approaching maturity, and the ship's 3D product model is complete. However, maintaining design stability depends on currently immature technologies fitting within the space, weight, cooling, and power reservations allotted them within the ship. Construction to date has been impeded by critical technology system delays, material shortages, and engineering challenges.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Complete three-dimensional product model	●
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

CVN 78 Program

Technology Maturity

According to the Navy, 7 of the 13 critical technologies for CVN 78 are mature, and the remaining 6 are approaching maturity. To meet required installation dates aboard CVN 78, the Navy produced several of these technologies, such as the volume search radar (VSR), prior to demonstrating their maturity—a strategy GAO's prior work has shown introduces risk of late and costly design changes and rework. The VSR is a component of the dual band radar (DBR), which has been delivered to CVN 78, and is undergoing design modifications needed to complete shipboard integration. According to the Navy, testing in the spring of 2015 will show whether these modifications were successful or a more extensive redesign of the system is required, which could delay DBR deliveries by up to 4 years. Deficiencies affecting water twister components—used to absorb energy when arresting aircraft—of the advanced arresting gear (AAG) technology continue to disrupt the system's development. Recent water twister redesign proved unsuccessful in testing last year. The Navy resolved problems with the redesign and is planning for concurrent testing. Despite these steps, the Navy forecasts AAG land-based testing to be complete in August 2016—a new delay of nearly two years—and after the Navy has accepted CVN 78 delivery. The electromagnetic aircraft launch system (EMALS) has successfully launched aircraft during land-based testing using a single launcher and four motor generators. The shipboard system will employ a more complex configuration with more launchers and generators sharing a power interface.

Design Maturity

CVN 78 completed its 3D product model in November 2009—over a year after the construction contract award. While the model is now considered functionally complete, maintaining design stability depends on technologies fitting within the space, weight, cooling, and power reservations allotted them. Shipboard testing may reveal a need for design changes. Also, as construction progresses, the shipbuilder is discovering "first-of-class" type design changes, which it is using to update the model prior to CVN 79 construction.

Production Maturity

According to program officials, CVN 78 is approximately 70 percent complete. Lead ship procurement costs for the lead ship have grown by over 22 percent since construction authorization in fiscal year 2008 due in part to problems encountered in construction. Out-of-sequence work driven largely by material shortfalls, engineering challenges, and delays developing and installing certain critical technologies the Navy provides to the shipbuilder for installation has affected construction progress.

Other Program Issues

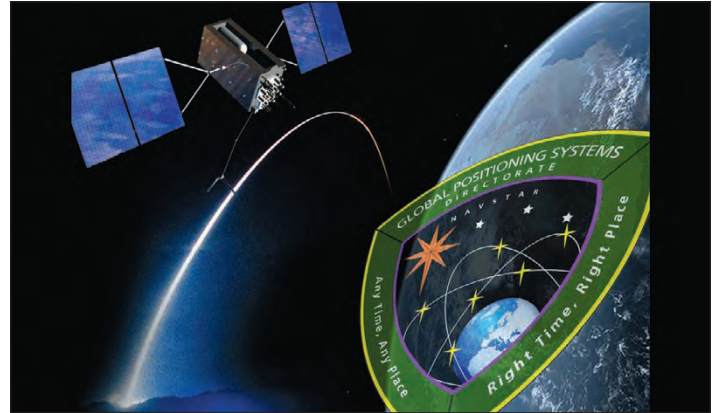
The Navy deferred award of the CVN 79 detail design and construction contract from late fiscal year 2013 to the first quarter of fiscal year 2015. According to the Navy, continuing contract negotiations provide an opportunity to incorporate process improvements into construction plans. The Navy has undertaken an in-depth review of CVN 79 requirements and capabilities to identify cost trades, which it hopes can facilitate an agreement on contract terms. These actions are consistent with recommendations we made in September 2013 to defer the CVN 79 construction contract and to conduct a cost-benefit analysis on Ford-class capability requirements and the time and money needed to field systems to provide these capabilities.

Program Office Comments

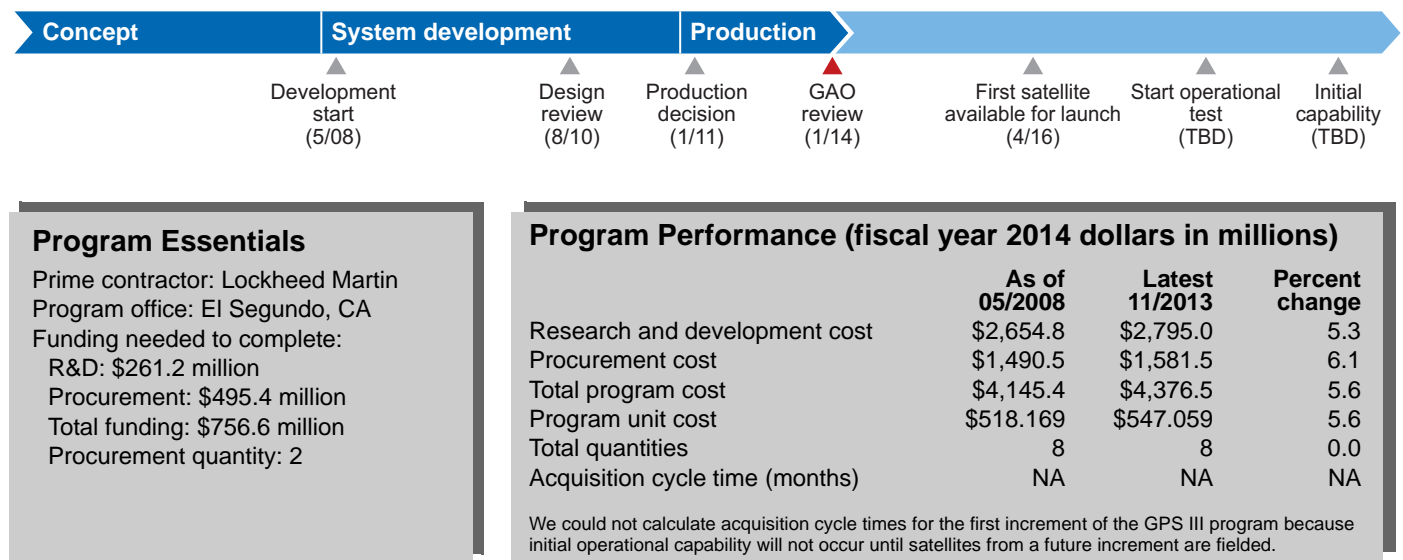
According to the program office, CVN 78 displaced 77,000 tons and was 70 percent complete at launch—the highest levels achieved in aircraft carrier new construction. The program office also reported that labor inefficiencies during ship erection are past and the principal risk remaining is in shipboard testing. Concerns over system integration within platform space, weight, and power reservations have been resolved. Land based testing for EMALS and DBR has progressed enough that program officials do not anticipate significant redesign. Further, the AAG test schedule remains on track to support ship delivery and sea trials. Lastly, the Navy plans to modify the CVN 79 construction preparation contract to extend the terms of the contract and avoid a production break during negotiations on the detail design and construction contract without delaying ship delivery. Program officials also provided technical comments that were incorporated where deemed appropriate.

Global Positioning System III (GPS III)

The Air Force's Global Positioning System III (GPS III) program plans to develop and field a new generation of satellites to supplement and eventually replace GPS satellites currently in use. Other programs are developing the ground system and user equipment. GPS III is to be developed incrementally. We assessed the first increment, which intends to provide capabilities such as a stronger military navigation signal to improve jamming resistance and a new civilian signal that will be interoperable with foreign satellite navigation systems.



Source: U.S. Air Force.



Program Essentials

Prime contractor: Lockheed Martin
 Program office: El Segundo, CA
 Funding needed to complete:
 R&D: \$261.2 million
 Procurement: \$495.4 million
 Total funding: \$756.6 million
 Procurement quantity: 2

The GPS III program's eight critical technologies have been assessed as mature, but three have yet to complete qualification testing. The program reported that its design and production processes are currently mature and a prototype was constructed to reduce risk. However, design changes have been required due to issues identified in testing. Late hardware delivery resulted in delayed testing of the prototype. The GPS III program delayed the first space vehicle's availability for launch from April 2014 to April 2016—a 24 month delay—due to late hardware deliveries and technical problems identified in testing.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• <i>Demonstrate all critical technologies in a realistic environment</i>	
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	○
● Knowledge attained	Information not available
○ Knowledge not attained	Not applicable

GPS III Program

Technology and Design Maturity

The program office reports that all eight of its critical technologies are mature and that its design is stable. Three of the GPS III critical technologies, including the timekeeping system and the key GPS signal generator, have not yet completed qualification testing, which is behind schedule. Based on the number of design drawings released to manufacturing, the design has been mature since the program's 2010 design review. However, design changes have been required due to problems identified in testing of key components. The program office reported that it has demonstrated that the design can meet requirements by testing a system-level integrated prototype that includes all key subsystems and components just with less redundancy in the GPS III satellites.

Production Maturity

At the time of GPS III's production decision, the program office reported a level of manufacturing process maturity that indicated its processes were in control and production could begin. However, a complete GPS III satellite was not tested prior to the production decision nor has one been tested to date. To mitigate risk, the program developed a prototype to prove out production processes prior to integrating and testing the first space vehicle. Delivery of the prototype's navigation payload was delayed by a year, which the program office acknowledged resulted in some concurrency in developing and integrating the prototype and the first space vehicle. Program officials stated that the prototype helped the program identify problems and reduce assembly time required for the first space vehicle.

Other Program Issues

The program office recently moved its estimate for the first space vehicle's available for launch date from April 2014 to April 2016—a 24 month delay. This delay was in part driven by late hardware deliveries and multiple technical problems identified in testing, which have also negatively affected costs. The program office stated that the navigation payload for the first GPS satellite was delivered over a year late. The program is still working to address technical problems associated with the

mission data unit, the brain of the GPS III navigation mission. Testing revealed radio frequency isolation issues, which can result in signal degradation.

This delay more closely aligns the space vehicle's delivery with the availability of GPS III's ground system, GPS Operational Control Segment (OCX). The synchronization of GPS III's and OCX's schedules continues to be a risk. GPS III satellites cannot be integrated into the constellation or be considered operational until OCX Block 1 is delivered, which is planned for October 2016.

The program is considering dual launching GPS III satellites, potentially beginning as early as the fifth GPS III space vehicle. Our prior work has shown that design changes during production can have significant cost and schedule consequences, including expensive retrofitting and production delays.

Program Office Comments

The Air Force also provided technical comments, which were incorporated where deemed appropriate.

Ground/Air Task Oriented Radar (G/ATOR)

The Marine Corps' Ground/Air Task Oriented Radar (G/ATOR) is an active electronic scanned array three-dimensional short/medium range multi-role radar designed to detect cruise missiles, air breathing targets, rockets, mortars, and artillery. It replaces five different legacy radars. G/ATOR is a block acquisition; later blocks are mostly software upgrades. According to the program office, developmental testing concluded in August 2013, and a low-rate production decision took place in January 2014, followed by a March 2014 contract award.



Source: U.S. Marine Corps.



Program Essentials

Prime contractor: Northrop Grumman
 Program office: Quantico, VA
 Funding needed to complete:
 R&D: \$285.9 million
 Procurement: \$2,089.4 million
 Total funding: \$2,381.5 million
 Procurement quantity: 55

Program Performance (fiscal year 2014 dollars in millions)

	As of 08/2005	Latest 09/2013	Percent change
Research and development cost	\$372.4	\$981.1	163.5
Procurement cost	\$1,169.3	\$1,668.7	42.7
Total program cost	\$1,541.7	\$2,656.1	72.3
Program unit cost	\$24.089	\$46.597	93.4
Total quantities	64	57	-10.9
Acquisition cycle time (months)	66	133	101.5

The G/ATOR technologies are mature and its design is stable and demonstrated but its production processes are not yet mature. In addition, the program's reliability is beneath the value needed to meet requirements due to software issues. To address this shortfall, the program plans to develop and incorporate software fixes into low-rate initial production. There may be insufficient time to test all fixes prior to the start of production. Production processes were demonstrated on a pilot production line, but they did not demonstrate stable, adequate control. The program office intends to award a contract for four low-rate production systems in March 2014. According to the program office, these systems are needed to conduct operational and environmental testing in order to meet the initial operational capability.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ●
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control ○
- Demonstrate critical processes on a pilot production line ●
- Test a production-representative prototype ●

● Knowledge attained
 ○ Knowledge not attained

.... Information not available
 Not applicable

G/ATOR Program

Technology Maturity

All six G/ATOR critical technologies are fully mature. However, according to the program office, testing revealed issues with the radar's software causing it to require a reboot more frequently than anticipated. The problems are driven by a number of lower-level software issues with system startup, random crashes, operator control console freezes, and an unstable command and control interface. The G/ATOR program office has put together a plan to incorporate software fixes to correct system start up and prevent crashes. Some hardware alterations may be required. The program office plans to increase and improve system performance by upgrading the software integration lab to support accelerated testing and conducting field testing with users every six months to demonstrate reliability growth and operational relevance. In addition, the gallium nitride technology, which will be used to upgrade the radar's transmit and receiving modules, is maturing on schedule. This new semi-conductor technology is expected to achieve better performance at a lower cost and will be installed on the last low-rate production lot.

Design Maturity

According to the program office, the G/ATOR design is mature, with 100 percent of design drawings released and testing of system-level prototypes completed in August 2013, well after the critical design review but before the program enters production. Risk of additional design changes exists, due to modifications planned for the production units. If these modifications are not incorporated into the design and tested before beginning production, there may be schedule delays if the program chooses to continue production and retrofit systems at a later date.

Production Maturity

According to the program office, the G/ATOR production readiness review was completed in September 2013 and the program demonstrated that its manufacturing processes meet DOD's requirement for the start of low-rate production. However, the manufacturing readiness level does not indicate that its production processes are stable and in control as preferred by commercial best practices. The program plans to begin low-rate production with four systems in March 2014.

According to program officials, these systems are needed to conduct developmental, operational, and environmental qualification testing in order to meet the scheduled Block I initial operational capability.

Other Program Issues

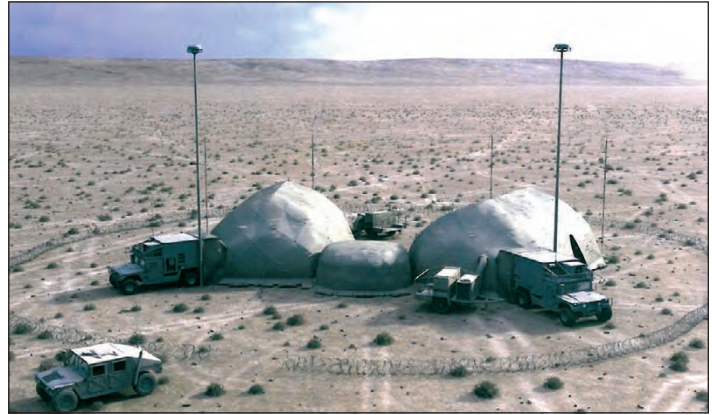
The program is authorized to procure 57 G/ATOR systems; however, only 45 were funded in the fiscal year 2014 President's budget. According to the program office, the 12 unfunded G/ATOR systems will require funding by fiscal year 2016 in order to meet initial operational capability. In addition, the concurrent development and production of G/ATOR may be adversely affected by personnel shortages caused, in part, by the impending retirement of highly experienced acquisition workforce staff.

Program Office Comments

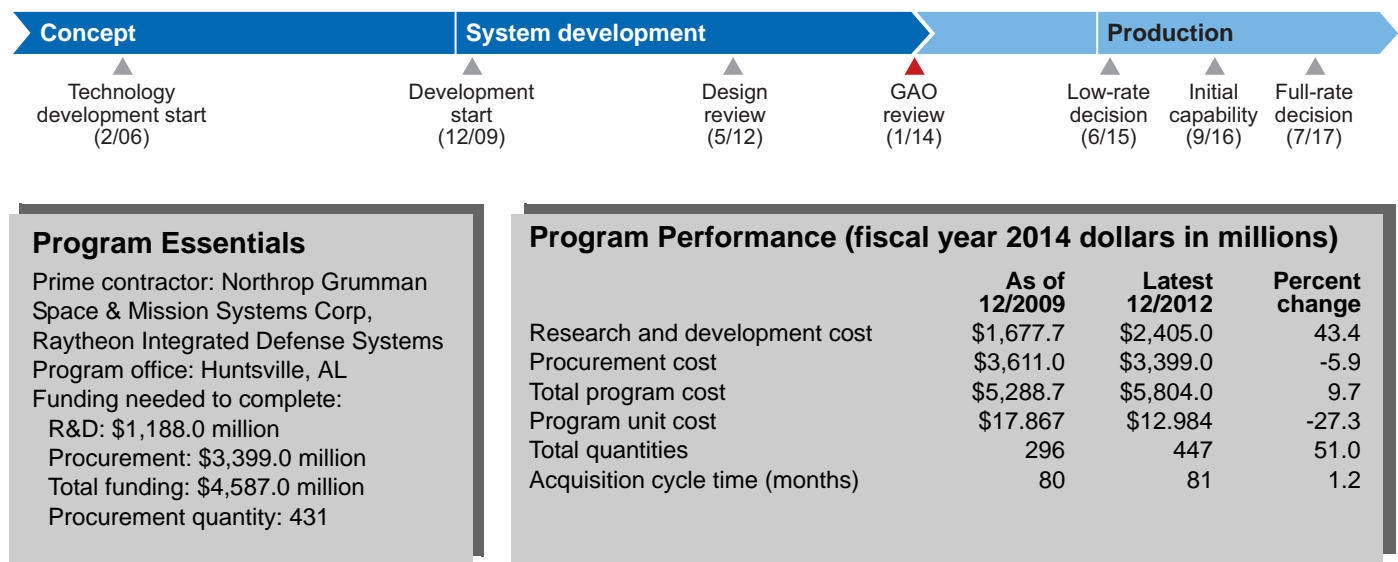
In commenting on a draft of this assesment, the program office noted that in October 2011, G/ATOR's performance requirements were revised, which resulted in a re-designation of the program to a major defense acquisition program. At that time, cost estimates were rebaselined; since then G/ATOR has remained on schedule and its total estimated cost decreased. This reduction is due, in part, from implementing better buying power and should cost initiatives. Technical comments were provided by the program office, which were incorporated where deemed appropriate.

Integrated Air and Missile Defense (IAMD)

The Army's Integrated Air and Missile Defense (IAMD) program is being developed to network sensors, weapons, and a common battle command system across an integrated fire control network to support the engagement of air and missile threats. The IAMD Battle Command System (IBCS) will provide a capability to control and manage IAMD sensors and weapons, such as the Sentinel radar and Patriot launcher and radar, through an interface module that supplies battle management data and enables networked operations.



Source: Northrop Grumman.



IAMD completed its critical design review in May 2012 with a stable design and technologies nearing full maturity, but does not plan to demonstrate the design can perform as expected until February 2014. IAMD's mission has not changed, but changes to its plans for integrating with other systems has significantly increased the size of its software effort, delayed its subsystem design reviews and increased development costs by over \$717 million. These changes include adding Patriot launcher and radar functionality directly onto the integrated fire control network and increasing the number of units by 146 to 431 total units. WIN-T integration is also a significant risk.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	○
● Knowledge attained	■■■■ Information not available
○ Knowledge not attained	Not applicable

IAMD Program

Technology Maturity

Program officials estimate that IAMD technologies will not be fully mature until its planned production decision in 2015. The IAMD program entered system development in December 2009 with its four critical technologies—integrated battle command, integrated defense design, integrated fire control network, and distributed track management—nearing maturity, according to an Army technology readiness assessment based on a notional design. The Army updated the technology readiness assessment in March 2011 based on the winning contractor's design and reached the same conclusion about the technologies' maturity. The Office of the Assistant Secretary of Defense for Research and Engineering concurred with the assessment, but noted that integration with the Warfighter Information Network-Tactical (WIN-T) is a significant risk. It also noted that the assessment was based on modeling and simulations of WIN-T and assumptions about performance. As a result, it recommended realistic, full-scale testing with WIN-T prior to a production decision.

Design Maturity

While the IAMD program has released nearly all of its total expected drawings and held a system level design review in May 2012, software problems and the Army's decision to operationalize the 32nd Test Battalion could cause further schedule delays and add substantial costs. For example, as a result of software development problems associated with the integrated battle command system, the IAMD program realigned software deliveries with key test activities. The revised software plan was approved in April 2013, resulting in a program delay of four months. Failure to properly develop, test, and integrate software could result in delay of capabilities being fielded to the warfighter. Also, the operationalization of the Patriot Test Battalion removes over 50 percent of the resources for both the Patriot and IAMD test programs. The IAMD and Patriot programs are working with the Army's test group to consider several options to mitigate potential risks, including delaying all test activities until Patriot test activities are complete and conducting tests with fewer assets. Further, tests of a fully integrated system-level prototype are not expected to begin until February 2014, over 20 months after design review.

Other Program Issues

IAMD's development costs have risen by about 48 percent, or over \$717 million, since beginning development and may increase further. The Army restructured the program in 2011 to incorporate the Patriot launchers and radars directly on the integrated fire control network and to increase the number of units procured from 285 to 431 to account for adjustments to the battalion force structure and accelerating the fielding of capabilities. However, overall procurement costs have decreased by \$194 million. According to program officials, increasing the number of units will provide for a common command and control at all organizational levels. Program officials estimate the size of the software development effort at over 6.6 million lines of code—a 37 percent increase over the estimate at development start. In addition, about 63 percent of this code will be newly developed code or auto-generated code which requires less effort to develop than newly developed or modified code.

Program Office Comments

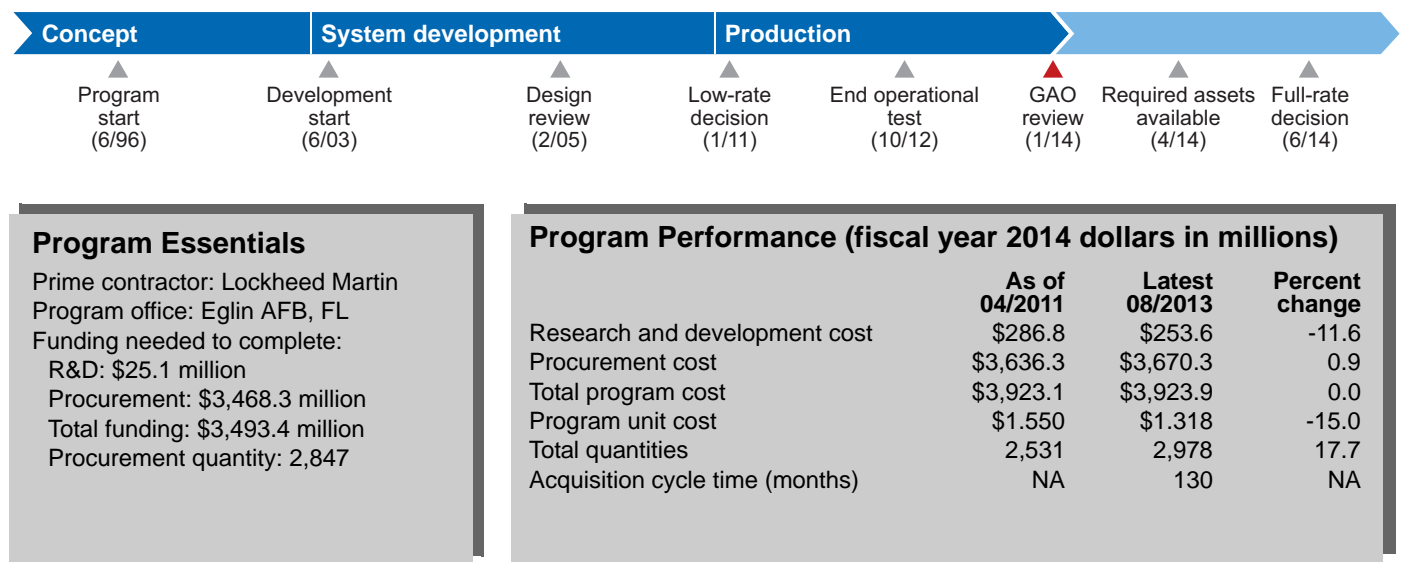
In commenting on a draft of this assessment, the program office noted that since the software replan in early 2013, deliveries of software have been on schedule allowing for successful demonstration of the IAMD hardware/software architecture in late 2013 to the user. This demonstration also served as risk mitigation for early integration leading up to the developmental test program and limited user test in fiscal year 2014 and fiscal year 2015. Active risk plans are in place to manage program risks and the program office continues to work with other programs which IAMD is dependent on to ensure technical and programmatic risks are managed properly across programs. The loss of the test battalion will potentially result in some changes to the IAMD test program, but those changes are actively being worked with all stakeholders. Currently, it does not appear this resource challenge will affect IAMD's schedule. All program changes depicted in this report are captured in appropriate acquisition decision memorandums and the program's acquisition program baseline. The program office also provided technical comments which were incorporated where deemed appropriate.

Joint Air-to-Surface Standoff Missile Extended Range (JASSM-ER)

The Air Force's JASSM-ER program plans to field a next-generation cruise missile capable of destroying the enemy's war-sustaining capability from outside its air defenses. JASSM-ER missiles are low-observable, subsonic, and have a range of greater than 500 miles. They provide both fighter and bomber crews the ability to strike heavily defended targets early in a campaign. JASSM-ER is a follow-on program to the JASSM baseline program. The two missiles' hardware is 70 percent common and their software is 95 percent common.



Source: U.S. Air Force.



The JASSM-ER program has experienced production issues that have resulted in delays to the full-rate production decision and may delay the deliveries required to provide for initial availability. The program has yet to accept any ER missile deliveries due to these production issues. Although significant, production issues are primarily limited to the new ER missile engine, as the rest of baseline and ER missile production has generally proceeded on schedule. Sequestration cuts for fiscal year 2013 have resulted in the Air Force deferring some missile purchases beyond fiscal year 2017, expanded obsolescence risk, and caused an increase in unfunded requirements.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	....
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	....
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

JASSM-ER Program

Technology Maturity

According to the program office, JASSM-ER's five critical technologies—the engine lube system, engine system, fuze, low observable features, and global positioning system—are mature and have been tested in a realistic environment using a production-representative test missile.

Design Maturity

JASSM-ER's design is currently stable and has been successfully demonstrated in operational tests. According to the program office, the number of configuration changes has decreased over time with only one significant design change in the last three years.

Production Maturity

The full-rate production decision for JASSM-ER has been delayed due to production issues which may also delay initial availability for the assets required. The program has yet to accept any ER missile deliveries because of these production issues.

The most significant of these issues is with the engine lubrication pump. Program officials stated they found that for some of the engine pumps produced, the internal metal components within the pump were chafing, releasing metal into the lubrication that could reduce performance. The program plans to change the component design and implement changes during production ramp up while relying on the current design and production line screening to remove faulty pumps in low-rate production. Also, the program experienced a supplier issue with the fuel control unit—an engine component that controls the fuel throttle, affecting missile speed and acceleration. They discovered the component supplier had used diluted glue which was weaker than what had been used during component qualification testing. Program officials stated all 30 of the first ER missiles produced are potentially affected and they placed a hold on accepting ER missile deliveries until an agreement is reached with Lockheed Martin on how to address those missiles.

Aside from engine lube pump and fuel control unit issues, the program states production of the remaining 98 percent of ER subsystems and components have generally proceeded according to

schedule. Production of the JASSM baseline variant has also largely been unaffected by ER production issues. Production of Lot 10 baseline missiles began in September 2013 with missile deliveries expected to begin in January 2014 while start of low-rate production of the second lot of ER missiles was delayed until January 2014.

Other Program Issues

According to the program office, sequestration cuts for fiscal year 2013 have resulted in the Air Force deferring some JASSM purchases to the out-years, increasing obsolescence risk, and increasing unfunded requirements. Prior to sequestration cuts, the program planned to reach its economic order quantity of 360 missiles per year in fiscal year 2016 but now plans to purchase missiles at the minimum sustainment rate for the foreseeable future. The program has some obsolescence issues that are not funded because of sequestration cuts, according to the program, which could lead to production gaps. Also, the program maintains sequestration cuts have resulted in unfunded requirements, such as warranties for upcoming missile purchases, production tooling for full rate production ramp up, and some evaluation testing.

Program Office Comments

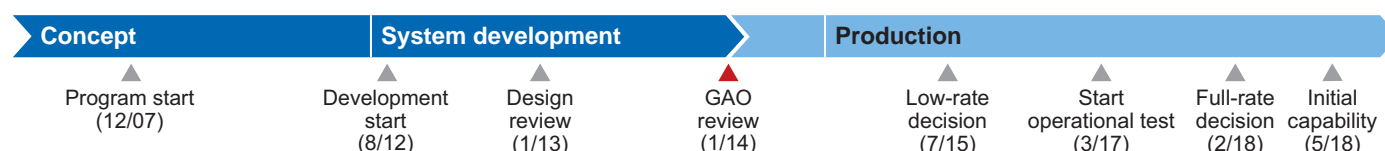
In commenting on a draft of this assessment, the Air Force provided technical comments, which were incorporated where deemed appropriate.

Joint Light Tactical Vehicle (JLTV)

The Army and Marine Corps' JLTV is a family of vehicles being developed to replace the High Mobility Multipurpose Wheeled Vehicle (HMMWV) for some missions. The JLTV is expected to provide better protection for passengers against current and future battlefield threats, increased payload capacity, and improved automotive performance over the up-armored HMMWV; it must also be transportable. Two- and four- seat variants are planned with multiple mission configurations.



Sources: JPO JLTV EMD Industry Contractors (AM General, Oshkosh Corp. & Lockheed Martin)



Program Essentials

Prime contractor: AM General, Lockheed Martin, Oshkosh
 Program office: Harrison Township, MI
 Funding needed to complete:
 R&D: \$377.3 million
 Procurement: \$22,651.7 million
 Total funding: \$23,046.9 million
 Procurement quantity: 54,599

Program Performance (fiscal year 2014 dollars in millions)

	As of 10/2012	Latest 07/2013	Percent change
Research and development cost	\$1,001.1	\$981.0	-2.0
Procurement cost	\$22,661.3	\$22,651.7	0.0
Total program cost	\$23,699.8	\$23,650.5	-0.2
Program unit cost	\$0.433	\$0.432	-0.2
Total quantities	54,730	54,730	0.0
Acquisition cycle time (months)	125	125	0.0

JLTV's two critical technologies have been demonstrated in a realistic environment on prototype vehicles, according to program officials. In lieu of a critical design review, the program held a design understanding review in January 2013, and according to program documents, confirmed that all three contractors had more than 90 percent of design files under configuration control. A recent manufacturing readiness assessment concluded that all three vendors were on track to achieve production maturity by low-rate initial production. All variants are envisioned to meet transportability requirements, and testing is ongoing to confirm this with production representative versions

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ●
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

JLTV Program

Technology Maturity

According to the program office, its critical technologies—underbelly protection armor and side-kit armor—are fully mature. According to program officials, ballistic testing conducted since November 2012—including armor samples, vehicle cabs, and chassis—confirmed this, and both technologies have been demonstrated in fielded systems. However, integrating the technologies to meet all system-level requirements for transportability, protection, and mobility could prove challenging,

Design Maturity

The program office did not hold a formal critical design review for JLTV, but conducted design understanding reviews with contractors between December 2012 and January 2013. According to program officials, these reviews were at a level of detail similar to a critical design review and were held to support the requirement for mature vehicle designs at the time of contract award for system development. At the time of these reviews, all long-lead and critical designs had been completed and all three contractors had more than 90 percent of the design files under configuration control. The Office of the Deputy Assistant Secretary of Defense (Systems Engineering) affirmed that the exit criteria for system development had been satisfied. According to program documentation, contractors will maintain responsibility for configuration control and will inform the government of changes. The government will assume control of the design after the planned award of one low-rate initial production contract in 2015.

Production Maturity

The Army does not intend to use process capability index data to assess production maturity, as recommended by our best practices. Instead, it intends to use other metrics, such as predicted assembly times and feasibility studies to assess production maturity by the production readiness review, scheduled for September 2014. The program recently conducted a manufacturing readiness assessment with all three vendors to evaluate manufacturing readiness, including a self-assessment of manufacturing readiness levels by the vendors. The program office believes all three vendors are on track to be production capable by

low-rate initial production contract award in 2015. Production processes are not expected to be fully in control as program officials noted that tooling will not be fully documented until this point due to the large capital investment required.

Other Program Issues

On the basis of the knowledge gained from the technology development phase, the Army and Marine Corps concluded the JLTV could not meet requirements for both protection levels and transportability because of weight and relaxed the requirement to transport the vehicle by helicopter at high altitude and at certain temperatures. Program officials acknowledge some risk still exists in vehicles achieving relaxed weight requirements, but the prototype weigh-ins were on track, thus diminishing risk. Prototype vehicle testing will continue through October 2014, and the results will be used to determine whether the vehicles meet system requirements. Army officials recognize that the test schedule is compressed, and that slips in the limited user test could result in a slip of the program's production decision planned for July 2015. However, program officials believe that the results of testing will be available in sufficient time.

At the end of the system development phase, a low-rate initial production contract will be awarded to a single source. The program office will seek approval to limit competition to the three current vendors, but if not approved will revert to a full and open competition strategy. The program office does not believe there are any viable sources for JLTV production other than the three current vendors.

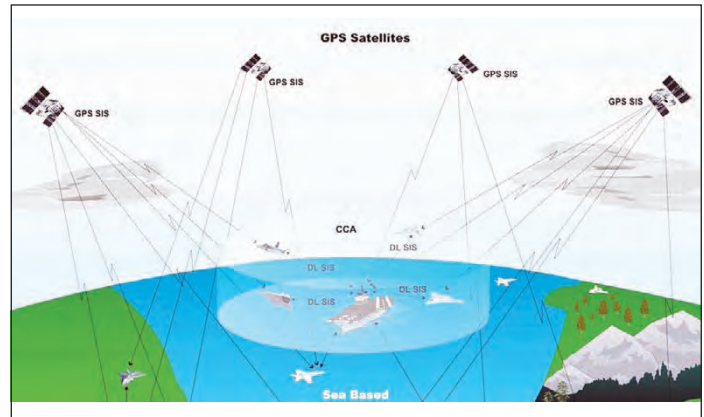
Finally, the Army plans to begin procuring JLTV while simultaneously procuring the Armored Multi-Purpose Vehicle. The simultaneous procurement of these programs is expected to continue for a decade or more.

Program Office Comments

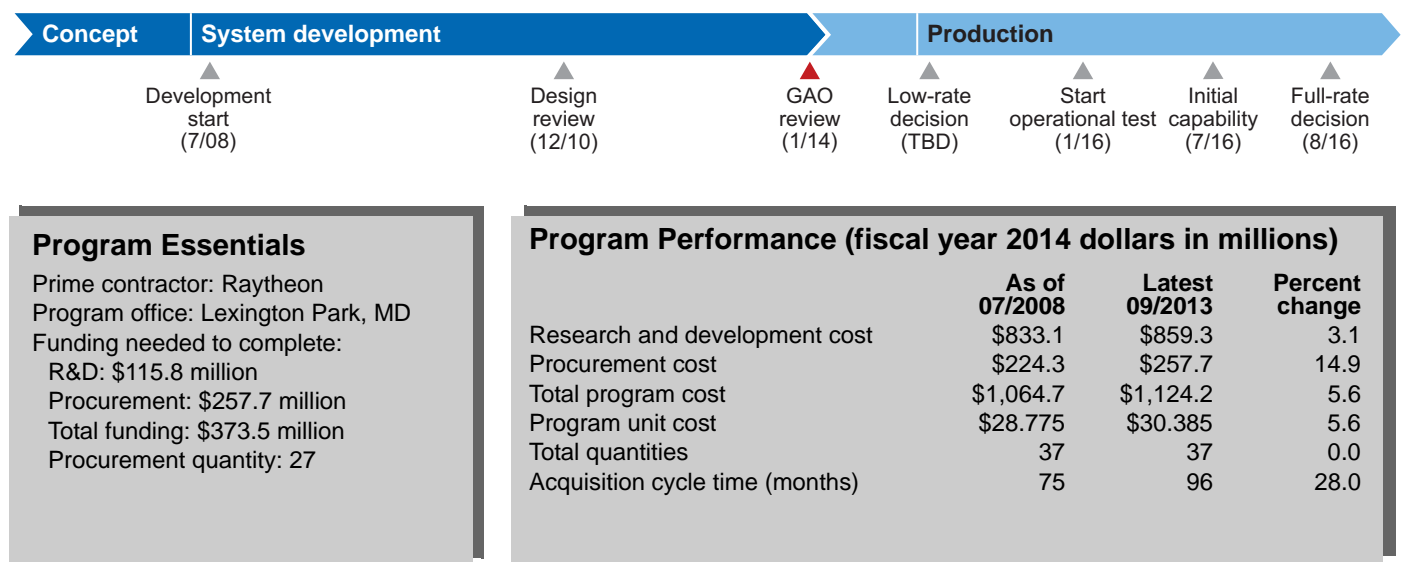
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Joint Precision Approach and Landing System Increment 1A (JPALS Inc 1A)

JPALS Increment 1 is a Navy-led program to develop a GPS-based aircraft landing system to replace current radar-based systems on its ships. It is designed to provide reliable precision approach and landing capability in adverse environmental conditions and improved interoperability. Increment 1A is the ship-based system and increment 1B will integrate JPALS with sea-based aircraft. Both are needed to provide the full capability. We assessed increment 1A and made comments on increments 1B, 2, and other follow-on efforts.



Source: U.S. Navy.



JPALS Increment 1A's two critical technologies are mature and have been demonstrated in a realistic environment. Program officials reported completing baseline software development as of April 2012. The program began system-level development testing in July 2012 and sea-based testing in December 2012. The program completed 108 integrated flight tests with no major anomalies reported. Increment 1A's production decision scheduled for November 2013 was cancelled due to budget reductions, with a new date to be determined. Ship availability delays for installation and procurement changes resulted in schedule and cost breaches, respectively, of thresholds in the program's baseline. Increment 1B is scheduled to start system development in 2015. Lead responsibility for Increment 2, land-based JPALS, transferred from the Air Force to the Navy beginning in fiscal year 2014.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

JPALS Inc 1A Program

Technology Maturity

JPALS Increment 1A's two critical technologies are mature and have been demonstrated in a realistic environment. Program officials reported demonstrating the technologies during sea-based flight testing in 2013. JPALS functionality is primarily software-based, and the program reported that its software development and integration effort was complete as of April 2012. The program will continue developmental testing, with operational testing planned to begin in 2016.

Design Maturity

The JPALS program held its critical design review in December 2010 and released all of its expected design drawings to manufacturing at that time. The JPALS design is currently stable, and the program began system-level development testing of a prototype in July 2012 to show that it will perform as expected. Sea-based testing began in December 2012 and program officials reported completing 108 integrated flight tests as of July 2013, with no major anomalies identified. Shore-based auto-landing demonstrations began in October 2013, and program officials reported completing 70 ship-based auto-landing demonstrations as of November 2013.

Production Maturity

According to JPALS program officials, the program has not identified any critical manufacturing processes and the system's hardware is comprised primarily of off-the-shelf components. The program has accepted delivery of all eight of its engineering development models, seven of which are production representative.

Other Program Issues

The program's production decision, scheduled for November 2013, was cancelled and a new date has yet to be determined. Program officials stated that budget reductions due to sequestration eliminated funding for the low-rate initial production contract. They noted that a new date will not be scheduled until the Navy resolves this funding issue. The program previously delayed the production decision from May 2013 to November 2013 because the aircraft carrier needed to conduct ship-based integrated testing was not available for installation. As a result, the program reported a schedule breach of the acquisition program baseline. The program

also extended planned production to avoid acquiring systems earlier than needed and moved the purchase of one unit from development to procurement. These changes increased procurement costs and resulted in a cost breach of a threshold set in the acquisition baseline.

System development for JPALS Increment 1B—which will integrate JPALS with sea-based aircraft—is scheduled for 2015. Program officials stated that increment 1B will be developed to provide JPALS functionality in a packaged way that allows for integration with any aircraft rather than tailoring efforts to each individual platform. Increment 2 is the land-based version of JPALS and system development is scheduled for 2015. Beginning with fiscal year 2014, lead service responsibility for JPALS Increment 2 transferred from the Air Force to the Navy.

Program officials stated that the recently conducted successful auto-land demonstrations may allow for the incorporation of capabilities planned for future increments. Incorporating auto-land and unmanned aerial vehicle capabilities into increments 1A and 1B will provide enabling technology for the Navy's future ship classes and the Unmanned Carrier-Launched Surveillance and Strike program for which JPALS was selected as the primary landing system.

Program Office Comments

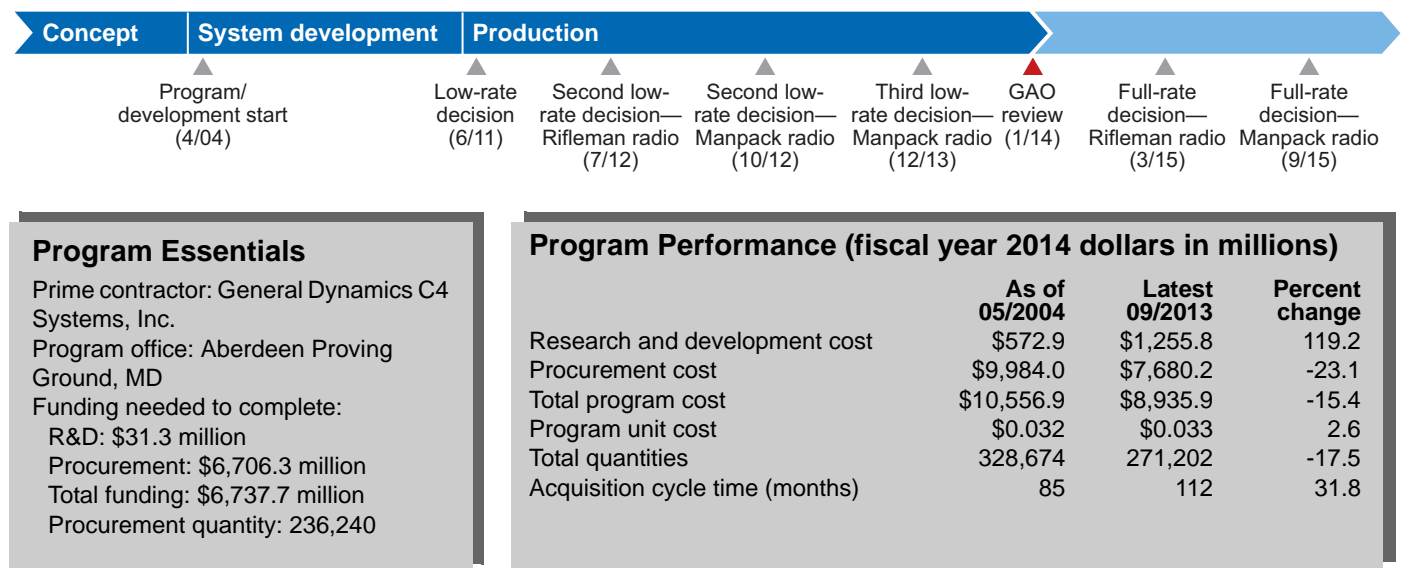
In commenting on a draft of this assessment, the JPALS program office noted that it concurred with our review and that flight testing was highly successful and the system performed as intended with no significant design or performance issues identified to date. The program is working aggressively with the Navy and the Office of Secretary of Defense to resolve the cost and schedule breaches, and anticipates corrective actions will be incorporated in the fiscal year 2015 President's budget submission. The program office also provided technical comments, which were incorporated where deemed appropriate.

Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)

DOD's JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. The JTRS HMS program is currently developing two radios: the Rifleman radio for unclassified use and the Manpack radio for use in a classified domain. A subset of the Manpack radios will be interoperable with the Mobile User Objective System (MUOS), a satellite communication system.



Source: © 2012 General Dynamics C4S.



The JTRS HMS program continues to conduct operational testing on both the Rifleman and Manpack variants and has demonstrated full maturity of all technologies, but has not demonstrated its production processes. Program officials have taken steps to address the Manpack reliability shortfalls identified during operational testing in May 2012 and plan to demonstrate the radio's capabilities during follow-on testing in May 2014. Full-rate production decisions for both variants have been delayed to fiscal year 2015 because of a change in the program's acquisition strategy to allow new vendors to compete for the contracts. In December 2013, the program received approval to increase the low-rate initial production quantity for the Manpack radio. The program is working with the Army to manage capability gaps resulting from both radios' full-rate production delays.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	●
● Knowledge attained	Information not available
○ Knowledge not attained	Not applicable

JTRS HMS Program

Technology Maturity

According to a program official, JTRS HMS has fully demonstrated the maturity of all its critical technologies for both the Rifleman and Manpack radios. The program has conducted operational testing on both variants for over four years, and plans to conduct additional testing in fiscal year 2014.

Design Maturity

According to program officials, the designs of both variants are stable, but reliability issues for the Manpack radio could require design modifications. Following operational testing in May 2012, DOD test officials reported that the Manpack was not operationally effective or suitable because it failed to demonstrate a reliability requirement. Program officials said they have taken steps to address the Manpack's reliability shortfalls and plan to demonstrate all remaining capabilities during follow-on testing in May 2014.

Production Maturity

According to JTRS HMS officials, the program's manufacturing readiness is at a level consistent with DOD guidance, but not yet at a level that demonstrates that its critical manufacturing processes are in control.

Other Program Issues

Both variants of JTRS HMS have experienced additional schedule slips since last year's assessment. The program revised its acquisition strategy following an Office of the Secretary of Defense directive that JTRS HMS conduct full and open competition for the full-rate contracts for both variants. As a result, the program office expects the full-rate production decisions for the Rifleman and Manpack radios to slip from the second half of fiscal year 2013 to March and September 2015, respectively. Prior to the full-rate production decisions, the program must solicit proposals from new vendors and, according to program officials, will likely award new contracts and test new radios. The Army would have to demonstrate that these new radios meet the Rifleman and Manpack requirements in an operationally-realistic environment. This delay puts the program nearly three years behind the originally scheduled full-rate production decisions for the Rifleman radio in May

2012 and the Manpack radio in December 2012. The program manager said he is working with Army operations and resource management staff to manage capability gaps resulting from both radios' full-rate production delays. They will establish deployment quantities and locations for the HMS radios procured through low-rate initial production to meet the Army's immediate needs. The program received approval for an additional lot of 1,500 Manpack radios in December 2013, but has not received authorization to increase the low-rate initial production quantity for the Rifleman radio over the current level set by the Office of the Secretary of Defense in July 2012.

Additionally, demonstrating the Manpack with the MUOS antenna and waveform remains a technical risk for the program. The JTRS HMS program is currently scheduled to field the MUOS-capable Manpack radios in 2014, but officials stated that they will wait to demonstrate the Manpack with the MUOS antenna and waveform until after the MUOS program successfully completes its own operational testing, which is scheduled for June 2014.

Program Office Comments

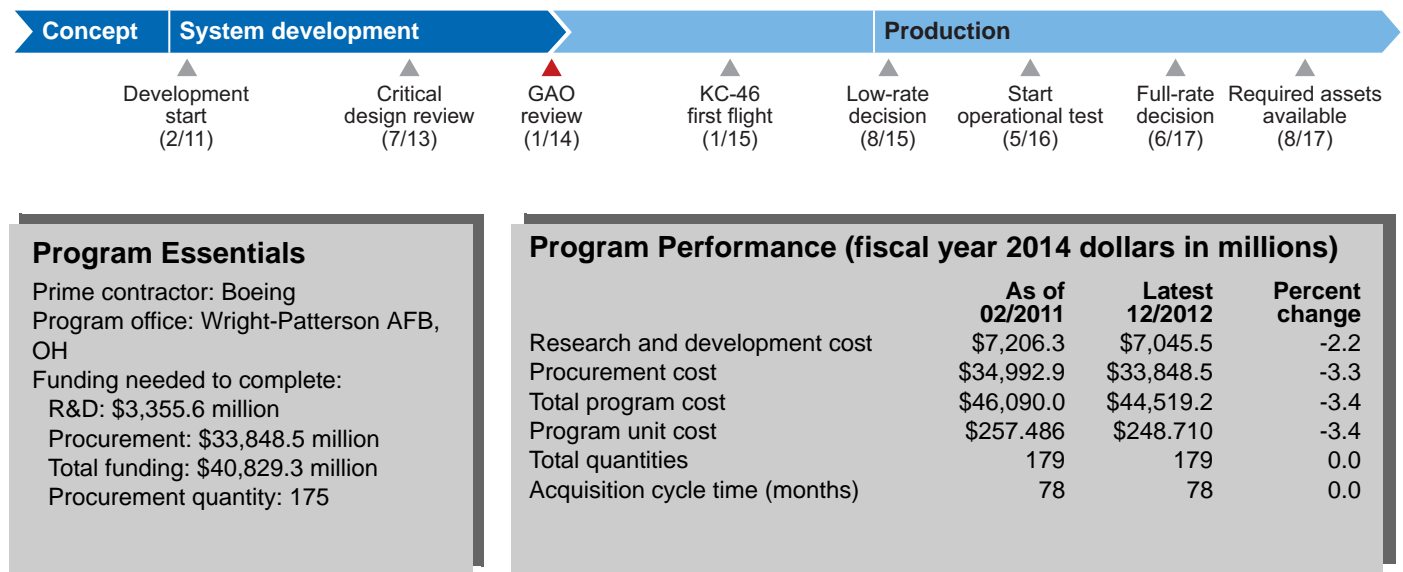
In commenting on a draft of this assessment, program officials noted that in 2012, HMS early operational tests were conducted on low-rate initial production variants of the HMS Manpack radio. Since this test, numerous corrected deficiencies have been implemented, including production improvements and extended environmental stress screening, significant improvement has been documented in follow-on performance verification testing and will be formally demonstrated at the Network Integration Evaluation 14.2 in May 2014. HMS Rifleman and Manpack radios have been successfully fielded and are in use by operational units in support of global operations. To meet operational needs, in December 2013, the Office of the Secretary of Defense approved an additional low-rate initial production allotment of HMS Manpack radios, while also indicating support for a multi-vendor, multi-award construct for HMS full rate production.

KC-46 Tanker Modernization Program (KC-46)

The Air Force's KC-46 program plans to convert an aircraft designed for commercial use into an aerial refueling tanker in order to refuel Air Force, Navy, Marine Corps, and allied aircraft. The program is the first of three planned phases to replace the Air Force's aging fleet of KC-135 aerial refueling tankers. The KC-46 has been designed to improve on the KC-135's refueling capacity, efficiency, capabilities for cargo and aeromedical evacuation, and to integrate defensive systems.



Source: © 2011 Boeing. All rights reserved.



The program held its critical design review in July 2013 with its critical technologies nearing full maturity and its design stable but not demonstrated. To reduce risk and improve schedule, Boeing decided to develop situational awareness software internally prior to the critical design review. This resulted in replacing one of the program's critical technologies and re-using software code. Boeing is currently manufacturing the four development aircraft, but test boom production has been delayed by almost a year due to design changes and late parts. The program has demonstrated that it can produce the required military subsystems in a production representative environment, but these processes will not be in control by the low-rate production decision. The Air Force and Boeing are working through software and hardware integration and flight test risks.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	○
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

KC-46 Program

Technology Maturity

The KC-46 entered system development with its critical technologies—a three-dimensional display to monitor and enable aerial refueling activities and a software module designed to increase situational awareness—nearing full maturity, but not yet demonstrated in a realistic environment. In March 2013, almost four months before the program's critical design review, Boeing decided to develop the situational awareness software internally. Boeing's version of this development effort replaced the prior software modules with a new one. The new software module is nearing full maturity, but has not yet been demonstrated in a realistic environment. To reduce risk and improve schedule, Boeing re-used some of the situational awareness software code from prior programs. The program plans to fully mature its critical technologies prior to its low-rate production decision.

Design Maturity

The program held its critical design review in July 2013 with over 90 percent of its design drawings releasable, but before fully maturing its technologies and testing an aircraft that integrates the military sub-systems. The program will not begin testing an aircraft that integrates military sub-systems until January 2015, 18 months after its critical design review. Best practices call for completing a full system-level prototype demonstration by the critical design review in order to show that the design is capable of meeting performance requirements.

Production Maturity

Boeing has begun production of the four development aircraft, and is also manufacturing a test refueling boom and a boom for the first development aircraft. Test refueling boom production has been delayed by almost a year due to design changes and late parts deliveries. Boeing officials said the test refueling boom is a risk reduction effort and lessons learned will be applied to future boom builds. The program reported that it is primarily using manufacturing readiness levels to assess manufacturing risk. As of July 2013, the program demonstrated that it is capable of producing the applicable military subsystems, such as several aerial refueling and defensive subsystems, in a production representative environment. The low-rate initial production decision

is currently scheduled for August 2015, but the program will not have its production processes for military subsystems in control at that time as recommended by best practices.

Other Program Issues

The Air Force has identified software and hardware integration and the aggressive nature of the KC-46 flight test schedule as top program risks. While most software and hardware integration has progressed according to plan, these efforts have largely addressed commercial rather than military unique components to date, and some aerial refueling and avionics software has not been delivered on time. The flight test pace is more aggressive than other military aircraft development programs, and Boeing's test approach requires a significant amount of coordination among key stakeholders. The program office and Boeing are working together to mitigate these risks by, for example, conducting dry runs prior to flight testing.

Program Office Comments

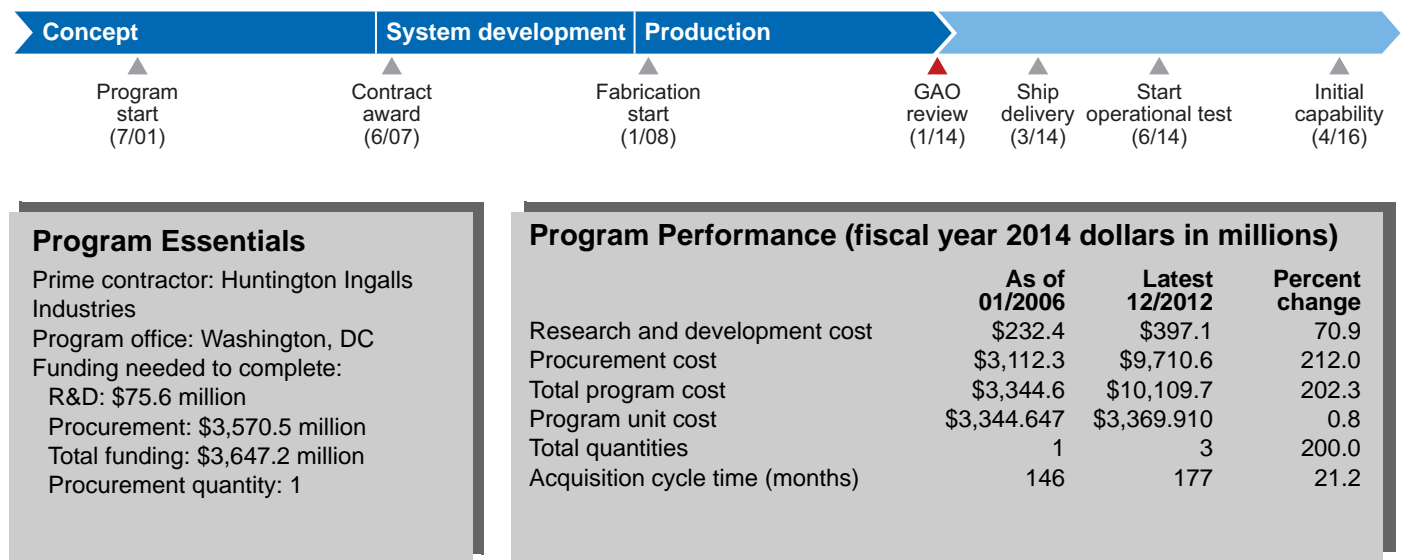
In commenting on a draft of this assessment, the program stated they mitigated risk by negotiating the competitive fixed-price incentive development contract with firm-fixed and not-to exceed pricing for production. The program noted that about 50 percent of the development work has been completed thus far and Boeing has met or exceeded all contractual requirements. The program is closely tracking software as a risk, however, it does not believe there are significant software-related issues at this time. The program further stated that it plans to mitigate the risk posed by concurrency by ensuring that adequate testing is completed prior to the production decision. In addition, Boeing's contract requires it to incorporate fixes into production aircraft at no additional cost. DOD and the Air Force also provided technical comments, which were incorporated as appropriate.

LHA 6 *America* Class Amphibious Assault Ship (LHA 6)

The Navy's LHA 6 class will replace the LHA 1 *Tarawa* class amphibious assault ships. LHA 6 class is based on the fielded LHD 8 and consists of three ships. The ships will feature enhanced aviation capabilities and are designed to support Marine Corps assets in an expeditionary strike group. LHA 6 construction began in December 2008 and ship delivery is expected in March 2014. LHA 7 construction began in July 2013 and delivery is expected in December 2018. The Navy intends to award the construction contract for LHA 8 in fiscal year 2017.



Source: Huntington Ingalls Industries



LHA 6 began construction in December 2008 with mature technologies and a design that was only 65 percent complete. After a 19 month delay, the Navy expects delivery will occur in March 2014. LHA 6 will also incur an estimated \$42.4 million in cost growth due to postdelivery rework of the ship's deck to cope with Joint Strike Fighter exhaust and downwash. Construction of LHA 7 (which largely shares the LHA 6 design) began in July 2013 and the program office believes that the issues that led to cost increases and schedule delays on LHA 6 have been largely resolved and are unlikely to cause problems for LHA 7. Design changes to LHA 8 are more significant and include the addition of a well deck. The Navy plans to competitively award a construction contract for LHA 8 and has awarded contracts with two shipyards to assist with early design work.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Complete three-dimensional product model	○
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

LHA 6 Program

Technology, Design, and Production Maturity

All LHA critical technologies were mature when the program awarded its construction contract in June 2007. Although not considered critical technologies, the program has identified an additional six key subsystems necessary to achieve capabilities. Five of these subsystems are mature. The sixth, the Joint Precision Approach and Landing System, is still in development, but LHA 6 can use backup aviation control systems to meet requirements. There are no new critical technologies expected for LHA 7 or LHA 8, but requirements for LHA 8 are still in development.

In January 2014, the Navy and the shipbuilder conducted acceptance trials on LHA 6 and Navy officials anticipate ship delivery will occur in March 2014, 19 months later than the contracted delivery date. At the time of acceptance trials, the LHA 6 design was at least 99 percent complete and construction was over 97 percent complete. LHA 6 began construction in December 2008 with only 65 percent of its design complete, and subsequent design quality issues have caused more design changes than anticipated and higher levels of rework. Following the delivery of LHA 6, the Navy will spend an estimated \$42.4 million to reconfigure the ship's flight deck to cope with exhaust and downwash from the Joint Strike Fighter.

Construction of LHA 7 (which largely shares the same design as LHA 6) began in July 2013 and flight deck modifications due to JSF are still being incorporated into the design. Officials, however, do not believe that this will interfere with the ship's construction. Other design changes to LHA 7 include a new firefighting system and updates to the radar and the command, control, communications, computers, and intelligence systems. Design changes to LHA 8 will be more significant as the Navy will incorporate a well deck that can accommodate two landing craft. Program officials note that the new design also allows for better maintenance of aviation capabilities. The program may also incorporate a flexible infrastructure—which would allow compartments to be reconfigured to meet changing mission needs with less rework—into some low risk areas of the LHA 8 design should the Navy determine that it results in lifecycle cost savings.

Other Program Issues

Program officials believe that as a result of increasing the number of design drawing reviews and ensuring additional lead time for material orders on LHA 7, the program will not experience the high level of rework that led to cost growth and schedule delays during construction of LHA 6. In order to improve quality and shipyard performance on LHA 7, the Navy included contract incentives of up to \$41 million; although officials note that it is too soon to determine whether the incentives are effective at keeping rework rates low.

The Navy intends to competitively award a construction contract for LHA 8, and in November 2012 awarded early industry involvement contracts to two shipbuilding contractors that it determined are capable of building the ship without major recapitalization. The contracts allow the shipbuilders to participate in early stage design work and investigate opportunities for potential cost reductions, and were recently modified to extend the period of performance past the original April 2014 contract expiration date.

Program Office Comments

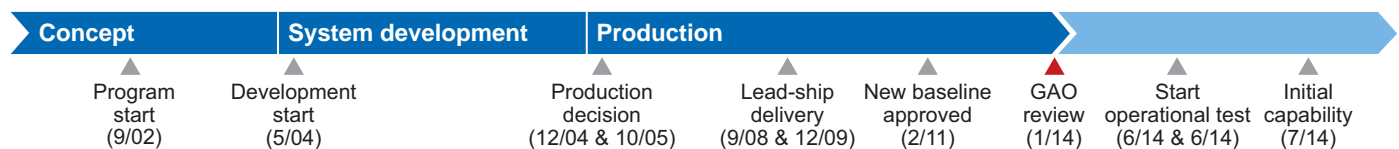
In commenting on a draft of this assessment, the program office stated that based on the success of LHA 6's acceptance trials, the Navy's independent assessor—the Board of Inspection and Survey—recommended that the Navy accept delivery of the ship. The extension of the periods of performance of the early industry involvement contracts for LHA 8 efforts will allow the joint industry/government team to continue working on identifying innovative ways to reduce the projected cost of the ship. The program office also provided technical comments, which were incorporated as appropriate.

Littoral Combat Ship (LCS)

The Navy's LCS is designed to perform mine countermeasures, antisubmarine warfare, and surface warfare missions. It consists of the ship itself, or seaframe, and the mission packages it deploys. The Navy bought the first four seaframes in two unique designs—one based on a steel semi-planing monohull (Freedom variant) and the other based on an aluminum trimaran hull (Independence variant)—and subsequently awarded a contract for a block buy of up to 10 ships to both contractors. We assessed both seaframe designs



Sources: Lockheed Martin (left); General Dynamics (right).



Program Essentials

Prime contractor: Austal USA, Lockheed Martin
 Program office: Washington Navy Yard, DC
 Funding needed to complete:
 R&D: \$704.1 million
 Procurement: \$18,775.1 million
 Total funding: \$19,631.6 million
 Procurement quantity: 36

Program Performance (fiscal year 2014 dollars in millions)

	As of 05/2004	Latest 12/2012	Percent change
Research and development cost	\$932.9	\$3,596.3	285.5
Procurement cost	\$496.0	\$26,214.6	5,185.2
Total program cost	\$1,428.9	\$30,027.0	2,001.4
Program unit cost	\$357.225	\$577.442	61.6
Total quantities	4	52	1,200.0
Acquisition cycle time (months)	41	122	197.6

Cost data are for the seaframe only. Research and development funding includes detail design and construction of two ships. DOD recently announced plans to reduce total seaframe quantities to 32.

The LCS seaframe program has demonstrated the maturity of 16 of its 18 critical technologies and continues to make design and production process changes. Additional design changes have been endorsed by the LCS Council for fiscal year 2015: bridge wings and a seven-meter rigid hull inflatable boat for the Independence variant and stronger stern ramp for the Freedom variant. The Navy accepted delivery of LCS 4 in September 2013, a delay of 6 months, and is in steady production with 12 hulls under contract and/or construction. The next block-buy is scheduled for fiscal year 2016, when 24 seaframes will already be delivered, constructed, or under contract.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Complete three-dimensional product model ●
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

LCS Program

Technology Maturity

Sixteen of the 18 critical technologies for both LCS designs are mature and have been demonstrated in a realistic environment. The two remaining technologies—LCS 1's overhead launch and retrieval system and LCS 2's aluminum structure are nearing maturity—according to our best practice standards. Though program officials believe that LCS 2's aluminum structure hull is mature as the ship is operational, there are still unknowns related to the hull structure. As a result, full maturity will not be demonstrated until the completion of shock and survivability trials to validate survivability and the ship's ability to achieve a 20-year service life. These tests are not expected to begin until August 2015.

Design and Production Maturity

The Navy started construction of LCS 1 and 2 without a stable design and has had to incorporate design changes on follow-on seaframes. LCS 1 and LCS 2 are still undergoing testing, and the Navy is incorporating design fixes for identified deficiencies into the designs of follow-on ships. In addition, a series of additional design changes for both variants have been approved by the LCS Council for fiscal year 2015; including bridge wings and a seven-meter rigid hull inflatable boat for the Independence variant and stronger stern ramp for the Freedom variant. LCS 4 experienced delays and was delivered six months after its expected contract delivery date of March 2013. LCS 5 through LCS 12 are currently in various stages of construction. The Navy is concerned about both contractors' ability to meet construction schedules without impacting follow-on hulls.

LCS 1 completed a ten-month deployment to the western pacific in December 2013 where it operated out of Singapore. During this deployment it encountered two significant engineering issues that significantly curtailed its ability to get underway: the lubrication cooling system ruptured and the ship service diesel engine generator had reliability issues. In addition to these engineering issues, LCS 1 had a number of combat system and other material failures; including radar underperformance and the combat system unexpectedly rebooting during operations.

Other Program Issues

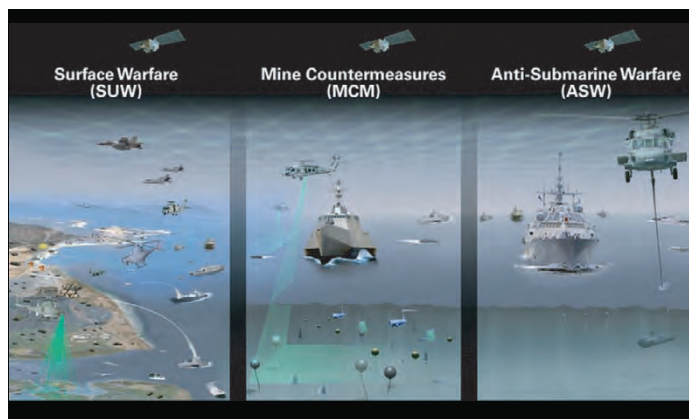
The Navy added 20 permanent berths to LCS 1 to support additional manning for its deployment to Singapore in 2013. In May 2013, the Navy determined that additional permanent accommodations for a total crew size of 98 should be incorporated in all LCS class ships. The LCS program executive office has been directed to add these permanent accommodations through either forward -or back-fitting the ships. Although the habitability modification installed on LCS 1 in support of its deployment did not include the addition of increased storage and water supplies, the forward fit installs will address the required services and auxiliary system modifications associated with the installation of the additional berthing. Following LCS 1's 2013 deployment, the Navy will evaluate lessons learned and future manning options. The Navy expects to complete this evaluation in fiscal year 2014 and incorporate any proposed manning changes beginning in fiscal year 2015 ahead of the next block buy decision in 2016, when 24 seaframes will already be delivered, constructed, or under contract.

Program Office Comments

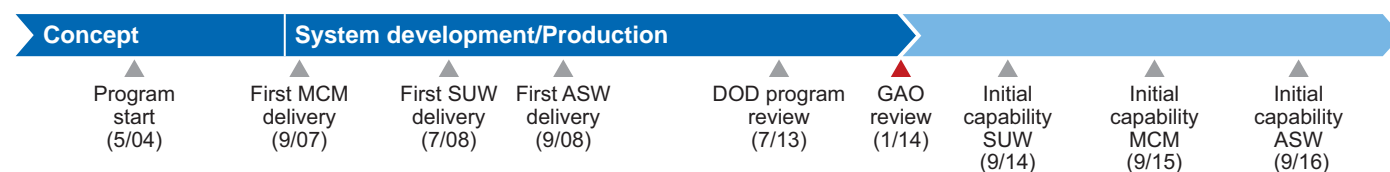
In commenting on a draft of this assessment, the program office noted that LCS 4 showed significant improvement from LCS 2 in level of completeness and number of high priority trial cards deficiencies at delivery. Twelve block buy ships are funded on the block buy contract and are in pre-production or construction, following thorough production readiness reviews. LCS 5 and 6 launched in December 2013. LCS 1 deployment successfully validated major portions of the LCS concept of operations for crew rotation and contracted overseas maintenance. Ship service diesel generator and seawater cooler reliability issues were satisfactorily addressed during deployment. Engineering changes have been incorporated to prevent and mitigate those issues in the future. Material failures of the radar were a result of a procedural error causing the system to reboot, however the radar performed to design specifications. The program office also provided technical comments, which were incorporated where deemed appropriate.

Littoral Combat Ship - Mission Packages (LCS MP)

The Navy's Littoral Combat Ship (LCS) will provide mine countermeasures (MCM), surface warfare (SUW), and antisubmarine warfare (ASW) capability using mission packages. Packages include weapons and sensors launched and recovered from LCS seaframes and operated from MH-60 helicopters and unmanned vehicles. The Navy plans to deliver capability to the fleet in increments. We are assessing the Navy's progress in achieving full baseline performance capability, including all planned increments needed to achieve this capability for each package.



Source: © Northrop Grumman Corporation.



Program Essentials

Prime contractor: Northrop Grumman Corporation M&TS
 Program office: Washington Navy Yard Washington, DC
 Funding needed to complete:
 R&D: \$1,647.1 million
 Procurement: \$3,656.4 million
 Total funding: \$5,334.9 million
 Procurement quantity: 51

Program Performance (fiscal year 2014 dollars in millions)

	As of 08/2007	Latest 01/2014	Percent change
Research and development cost	\$517.2	\$3,103.4	NA
Procurement cost	\$3,427.8	\$4,108.7	19.9
Total program cost	\$3,954.7	\$7,243.5	NA
Program unit cost	\$61.792	\$113.180	NA
Total quantities	64	64	0.0
Acquisition cycle time (months)	NA	NA	NA

The 2007 RDT&E cost estimate does not reflect full program costs and cost growth is not applicable. Current estimate does not include \$3.6 billion of procurement money for replacement and other items.

In November 2013, DOD approved the baseline for the LCS Mission Packages program and previously, in October 2012, transferred decision authority to the Navy which approved the programs milestone B decision. The Navy held the milestone B event, which normally indicates development start, in January 2014 but has been developing the packages since 2004 and has delivered eight partial packages. As a part of this event, the Navy produced the first full lifecycle cost estimate. The program's acquisition cost is now \$7.24 billion, an increase of \$3.29 billion based upon its 2007 estimate, which did not include full development costs. The Navy plans to deliver mission package capabilities in increments, the MCM and SUW mission packages are not currently expected to field their baseline performance capability until the Navy has purchased 32 and takes delivery of 24 seaframes.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ☐
- Demonstrate all critical technologies in a realistic environment ☐
- Complete preliminary design review ☒

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

☒ Knowledge attained
☐ Knowledge not attained

.... Information not available
 Not applicable

LCS Packages Program

Mine Countermeasures (MCM)

The Navy has accepted four packages without demonstrating that they meet requirements and plans to accept two more in fiscal 2014. The package will be fielded in four increments: the first intends to remove sailors from the minefield and improve mine detection, classification, and destruction over legacy vessels. Although DOD states that all systems in increment one are fully mature, developmental testing has shown performance problems that led to changes in planned tactics, removal of systems, and lowered testing requirements. For example, corrections to the mine-hunting sonar's reliability have yet to be validated in operational testing, and two systems, intended to sweep for and neutralize mines, had to be removed for safety and performance issues. Also, the Navy now requires multiple searches to identify mines, adding time to the process, and has lowered increment one testing requirements for mine clearance rates. If operational testing proves successful, this package will not be able to replace all legacy capability until increment three completion in fiscal 2017.

Surface Warfare (SUW)

The Navy has taken delivery of four packages, each comprised of two 30 millimeter guns, as well as a rigid hull inflatable boat prototype, boarding gear, and armed helicopters. Following the cancellation of the non-line-of-sight launch system, the Navy planned to field the Griffin missile in 2015 as an initial capability. However, program officials stated that the Navy is rethinking this and a solution is not yet known.

Antisubmarine Warfare (ASW)

The Navy restarted development of an ASW package with new requirements as the initial package was not going to deliver enough capability over legacy assets. The Navy is assessing a replacement, with initial delivery planned in 2016, that is expected to include, among other technologies, a variable-depth sonar—which, according to officials, performed well in initial tests—and a towed array. The maturity of these technologies has not yet been independently assessed.

Other Program Issues

The Navy held a preliminary design review in 2004, but the packages have substantively changed. The program held a milestone B event in January 2014 with an estimated acquisition cost of \$7.24 billion. Tests for increment one and two of the SUW and increment one of the MCM package are scheduled for fiscal 2014 and 2015 respectively. These assessments evaluate progress in achieving baseline performance capability, which includes all planned increments for each package. The Navy plans to purchase 32 LCS seaframes and take delivery of at least 24 by the time the baseline performance capabilities of the MCM and SUW packages are proven and fielded.

Program Office Comments

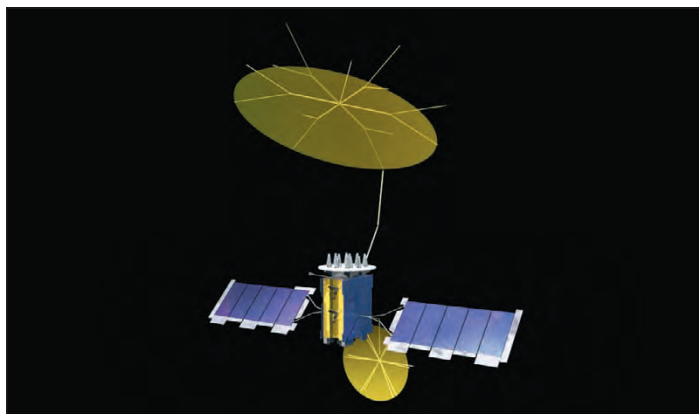
The Navy states that our assessment of program cost growth incorrectly compares the acquisition program baseline against a fiscal 2008 baseline, which does not reflect the total acquisition. Further, the Navy states that this assessment disregards near term operational requirements as the data presented indicates that the program should be delayed. The Navy also states that our assertion of excessive program risk, due to concurrency, is unfounded because developmental testing, combined with capability proven during early deployments, has significantly reduced technical risk. This is evidence, according to the Navy, that the LCS will successfully complete operational testing. Lastly, the current missile procurement was delayed due to sequestration; the Navy states that the program is on track to deliver a capability in late 2016.

GAO Response

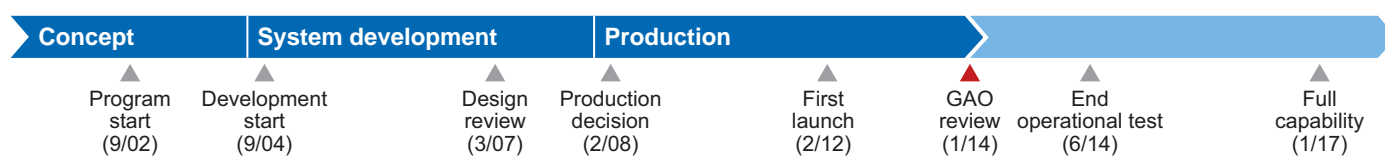
In comparing the 2007 estimate with the acquisition program baseline, we used the Navy's 2007 data, which included full procurement costs but only five years of development cost. The Navy has acquired eight packages without proving capability through operational testing. In the absence of a defined increment-based approach for the full baseline capability to sequentially gain knowledge and meet these requirements, the Navy's acquisition approach is not in accordance with best practices or DOD guidance in place at the time of our review.

Mobile User Objective System (MUOS)

The Navy's MUOS, a satellite communication system, is expected to provide a worldwide, multiservice population of mobile and fixed-site terminal users with increased narrowband communications capacity and improved availability for small terminal users. MUOS will replace the Ultra High Frequency (UHF) Follow-On (UFO) satellite system currently in operation and provide interoperability with legacy terminals. MUOS consists of a network of satellites and an integrated ground network. We assessed both the space and ground segments.



Source: © 2007 Lockheed Martin.



Program Essentials

Prime contractor: Lockheed Martin Space Systems
 Program office: San Diego, CA
 Funding needed to complete:
 R&D: \$176.9 million
 Procurement: \$975.1 million
 Total funding: \$1,152.0 million
 Procurement quantity: 1

Program Performance (fiscal year 2014 dollars in millions)

	As of 12/2004	Latest 09/2013	Percent change
Research and development cost	\$3,836.4	\$4,511.6	17.6
Procurement cost	\$3,192.1	\$2,867.4	-10.2
Total program cost	\$7,069.1	\$7,448.1	5.4
Program unit cost	\$1,178.186	\$1,241.345	5.4
Total quantities	6	6	0.0
Acquisition cycle time (months)	90	NA	NA

Latest acquisition cycle time could not be calculated because the most recent MUOS program baseline does not estimate dates for operational capability.

The MUOS program's critical technologies are mature, its design is stable, and according to the program office, its manufacturing process maturity has increased. The first satellite was launched in February 2012—26 months later than planned at development start—and the second satellite was launched in July 2013. Subsequent launches of MUOS satellites remain important due to the past operational failures of two UFO satellites and predicted end-of-life of on-orbit UFO satellites, one of which was taken off-line in November 2012. A remaining challenge is that users will not be able to utilize advanced MUOS capabilities in large part because of delays in the development, testing, and fielding of new user terminals. Current MUOS user terminal procurement and fielding are managed by the Army's Tactical Radios Project Office.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment
- Demonstrate all critical technologies in a realistic environment
- Complete preliminary design review

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained
 ●●●● Information not available
○ Knowledge not attained
 ●●●● Not applicable

MUOS Program

Technology, Design, and Production Maturity

The MUOS program's technologies are mature, its design is stable, and its manufacturing process maturity has increased. The first two satellites have been launched and three other satellites are being built. We could not assess whether critical manufacturing processes were in control as the program does not collect statistical process control data. The program has experienced quality problems in the past that resulted in cost increases and schedule delays; however, the number of manufacturing defects on the space segment has decreased over time. According to the program, multiple corrective action boards collect and track all defects in manufacturing processes and the program uses this data to assess the maturity of production. Examples of specific metrics used include number of defects per 1,000 hours of touch labor, amount of deferred work and associated risk, and rate of resolving nonconformance issues. According to the program office, these metrics indicate continuing increases in MUOS production maturity and show program goals are being met.

Other Program Issues

The first MUOS satellite was launched in February 2012, 26 months later than initially planned, and the second satellite was launched in July 2013. According to the program office, the remaining MUOS satellites are needed because most on-orbit UHF satellites are past their design lives. Two of these unexpectedly failed—one in June 2005 and another in September 2006—and a third was taken off-line in November 2012. Program officials stated that the required availability level of legacy UHF communication capabilities has been provided and based on the projected launch schedule for the remaining MUOS satellites, the required availability of legacy UHF communication capabilities is predicted to be maintained through May 2020.

Since 2007, we have reported that synchronizing deliveries of MUOS satellites with compatible Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) terminals has been a challenge. Launching MUOS satellites is important to sustain legacy UHF communications capability. However, utilization of over 90 percent of MUOS's planned capability is dependent on the development of the MUOS waveform—which completed formal

qualification testing in November 2012—and porting the MUOS capability onto operational user terminals. The Army's HMS program is developing the first operational terminal to incorporate the MUOS waveform. Additionally, according to the MUOS program, other vendors wanting to integrate the MUOS waveform into their radios are being supported with MUOS waveform software and government-operated MUOS test resources.

To date, the HMS program has conducted multiple developmental tests on the Manpack radio and an operational test was conducted in 2012. This testing, conducted without the MUOS waveform, found that the terminals did not meet all performance and reliability requirements. However, according to the MUOS program, the radio demonstrated improved performance at subsequent test events and was selected for fielding to Army units without the MUOS waveform due to the capability increases it would provide. Limited testing has been conducted on terminals with the MUOS waveform to date. Operational testing and initial fielding of the HMS terminals with the MUOS waveform is planned to begin in 2014.

Program Office Comments

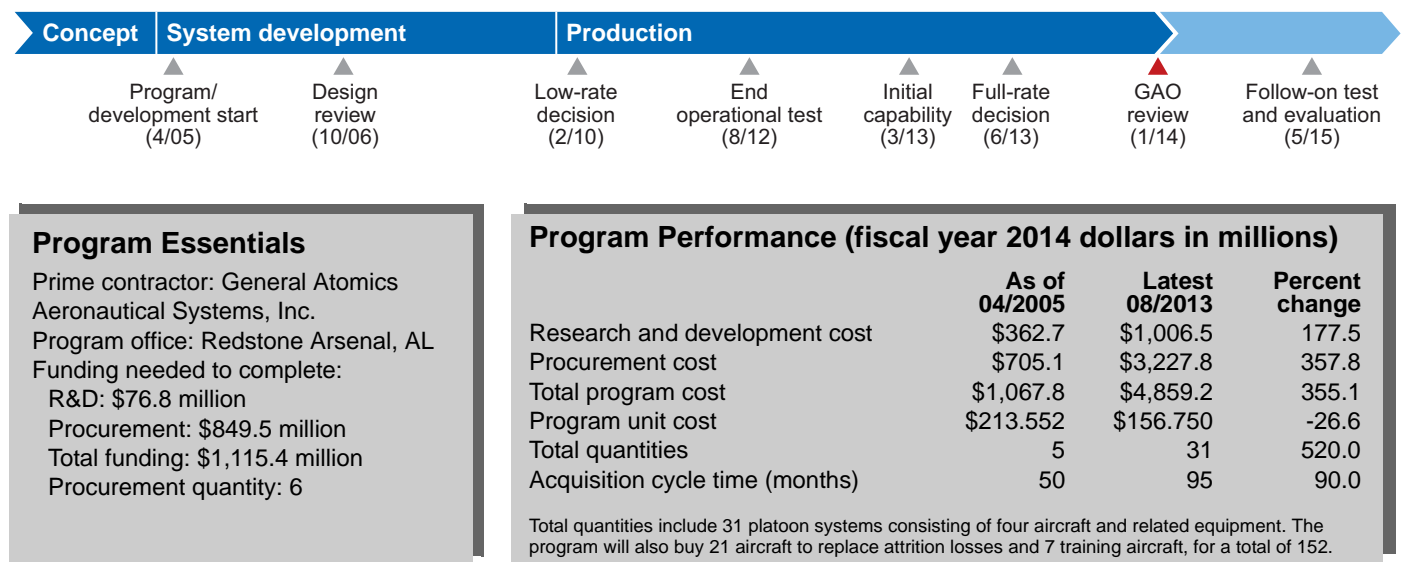
In commenting on a draft of this assessment, the program officials provided technical comments, which were incorporated as appropriate.

MQ-1C Gray Eagle Unmanned Aircraft System (MQ-1C Gray Eagle)

The Army's MQ-1C Gray Eagle unmanned aircraft system (UAS) will perform reconnaissance, surveillance, target acquisition, and attack missions either alone or with other platforms such as the Longbow Apache helicopter. Each platoon-sized system includes four aircraft, payloads, data terminals, automatic take off and landing systems, ground control stations, and support equipment. The Army procured less-capable quick reaction capability variants to address urgent needs, but these systems are not included as part of the Gray Eagle program.



Source: General Atomics Aeronautical Systems, Inc.



The Gray Eagle program received approval to begin full-rate production in June 2013 with its technologies, design, and manufacturing processes mature. However, design changes and supplier base issues put the program's cost and schedule at risk. Program officials said they are considering a change to the aircraft tail, which would be costly and require retrofitting the entire fleet. The program is also developing a new ground control station which will not undergo operational testing until May 2015. In addition, a production readiness review conducted in support of the program's full-rate production decision identified several high risk supplier base issues that pose uncertainty for the program's cost and schedule. The program is tracking these risks and program officials said its suppliers have mitigation strategies in place.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

MQ-1C Gray Eagle Program

Technology and Design Maturity

The Gray Eagle program reported that all five of its critical technologies are mature and have been demonstrated in a combat environment. Program officials stated that the design is generally stable; however, there is the potential for design changes if the program decides to integrate a new aircraft tail that the program's contractor is developing in response to an aircraft accident in 2009. Program officials said that integrating the new tail design would be costly as it would require retrofitting the entire Gray Eagle fleet, although it would provide increased reliability and endurance. A decision is expected in fiscal year 2014 on whether to move forward with the retrofit based on affordability considerations.

Production Maturity

The Gray Eagle's 2013 production readiness assessment reported that its manufacturing processes are mature and at the level recommended by DOD guidance for the start of full-rate production. The program was approved to begin full-rate production of 49 aircraft and support equipment in June 2013 and awarded the first of three planned full-rate production contracts in September 2013. However, the program is tracking several risks related to its supplier base. For example, the Gray Eagle prime contractor is currently flight testing a new aircraft engine to replace the legacy engine because the legacy engine supplier went into bankruptcy. Program officials noted they have enough engines on hand for the first full-rate production lot, identifying a new engine source poses technical, cost, and schedule risks to the program, according to the production readiness review. The program and the Defense Contract Management Agency are also tracking other risk items related to multiple suppliers' financial concerns as well as quality control, but program officials said its suppliers have mitigation strategies to address these risks.

Other Program Issues

The Gray Eagle system completed initial operational test and evaluation in August 2012. DOD's Director, Operational Test and Evaluation (DOT&E), found the system to be operationally effective with the potential to provide effective support to combat units and suitable at meeting its

performance and combat availability requirements. However, several recommended improvements were identified related to tactics, techniques, and procedures; training; and the design of the ground control station shelter. Specifically, DOT&E found that the Army needs to improve integration of Gray Eagle into employment concepts and improve soldier training. In addition, the design of the current ground control station degrades aircraft operator efficiency. According to the program office, the Army has already begun to address these issues and plans to re-evaluate them at the planned follow-on test and evaluation in May 2015. The follow-on test will also be used to assess new hardware and software the program is developing to replace the current ground control station as well as assess its net readiness capabilities. Once testing is complete, program officials said the Army will deploy the new ground control station to fielded units and will train Gray Eagle operators on the new system.

Program Office Comments

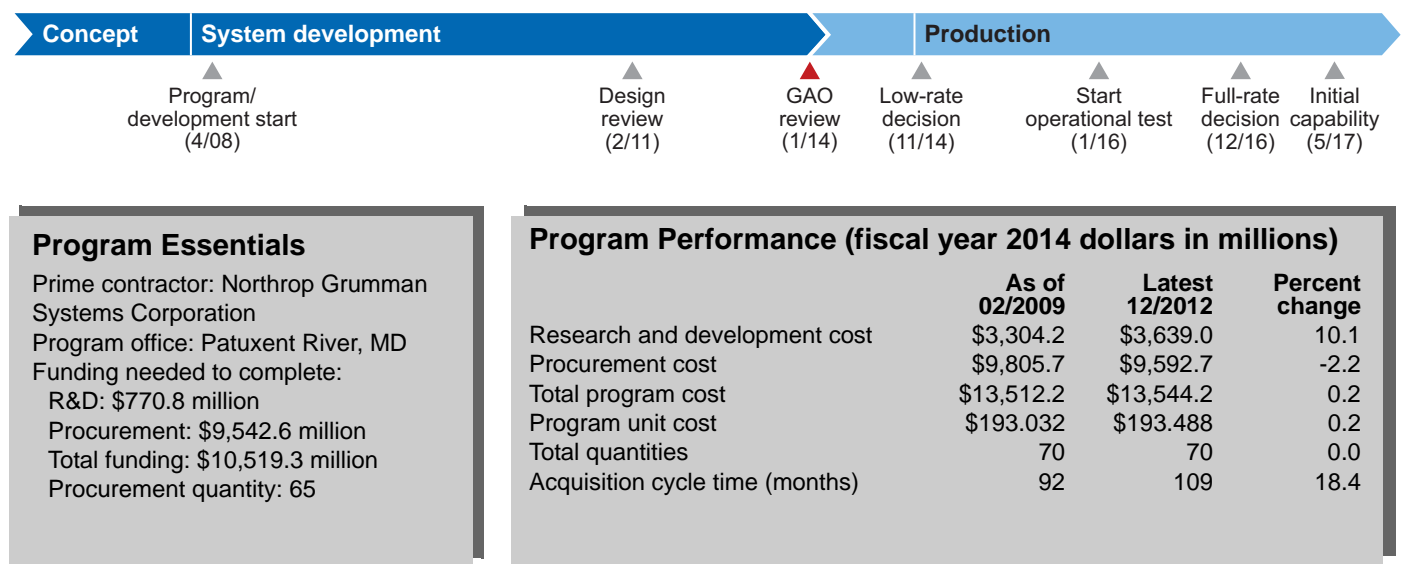
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated as appropriate.

MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)

The Navy's MQ-4C Triton is intended to provide a persistent maritime intelligence, surveillance, and reconnaissance (ISR) capability even when no other naval forces are present. Triton will operate from five land-based sites worldwide as a part of a family of maritime patrol and reconnaissance systems that recapitalizes the Navy's airborne ISR assets. Planned improvements include a signals intelligence capability and an upgrade to the systems communication relay. The Triton is based on the Air Force's RQ-4B Global Hawk air vehicle.



Source: Northrop Grumman.



The Triton's critical technology is mature, the design is stable—although not yet demonstrated—and the program reports that manufacturing processes will be ready to support low-rate production. Testing on the first development aircraft began in September 2012 and first flight occurred in May 2013. However, the program discovered design challenges during integration and testing and had its production budget reprioritized in fiscal year 2014. Alternatives for an air-to-air radar subsystem are being considered and the program's production decision has been delayed by about one year. The program office authorized the prime contractor to develop a new target baseline and schedule that takes into account the program's increased costs and schedule delays.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

MQ-4C Triton Program

Technology and Design Maturity

The Triton program's one critical technology—a hydrocarbon sensor—was found to be mature by an April 2011 technology readiness assessment. However, the air-to-air radar subsystem (AARSS), which will enable Triton to sense and avoid other aircraft, has faced developmental delays and cost overruns. As a result, the Navy ordered work to be stopped on the subsystem in April 2013 and is currently examining alternatives.

The Triton design is stable and according to the program office, all design drawings are releaseable to manufacturing, but a fully outfitted system-level prototype has not yet been tested. Testing of the first development aircraft began in September 2012, followed by first flight in May 2013. Program officials expect the second development aircraft, which was expected to be the first with a full sensor suite and a sense-and-avoid capability, to begin testing in 2014. However, as a result of developmental delays, they do not plan for AARSS to be incorporated on the aircraft until 2016 for operational evaluation. Software development and maturity also remain areas of potential risk. The program plans to utilize nearly 8 million lines of code, more than 20 percent of which will be new. Though some software integration challenges discovered during testing were resolved in 2013, two more phases of software development and installation are scheduled for completion before the aircraft enters into operational evaluation.

Production Maturity

In November 2011, the program received approval to build three air vehicles and ground stations, in part to demonstrate its manufacturing processes prior to production. Program officials noted that one of these three aircraft will no longer be produced because of new priorities within the Navy's budget. The program reports that manufacturing processes will be able to support low rate initial production after the production decision is made. The Triton aircraft is based on the Air Force's RQ-4B Global Hawk and uses sensor components and subsystems from other platforms. There are some structural changes to the airframe, but none of these require significant changes to manufacturing

processes. The program plans to award a contract for long lead material one year prior to the low-rate initial production contract award.

Other Program Issues

The Triton program's production decision has been delayed by about one year because of design adjustments to ensure airworthiness and software stability issues discovered during system integration and testing as well as the Navy's decision to reprioritize the program's production funding for fiscal year 2014. The program office authorized the prime contractor to develop a new target baseline and schedule to take into account increased costs and delays. Program officials expected to receive the revised baseline and schedule in December 2013. According to program officials, the delay has allowed the contractor to resolve some technical issues.

In September 2013, the Global Hawk program experienced an anomaly with a navigation system held in common with Triton. Though the Triton program did not experience the same anomaly, test flights were suspended until a work around was identified. The Air Force is continuing its investigation into the cause of the navigation system issue.

Program Office Comments

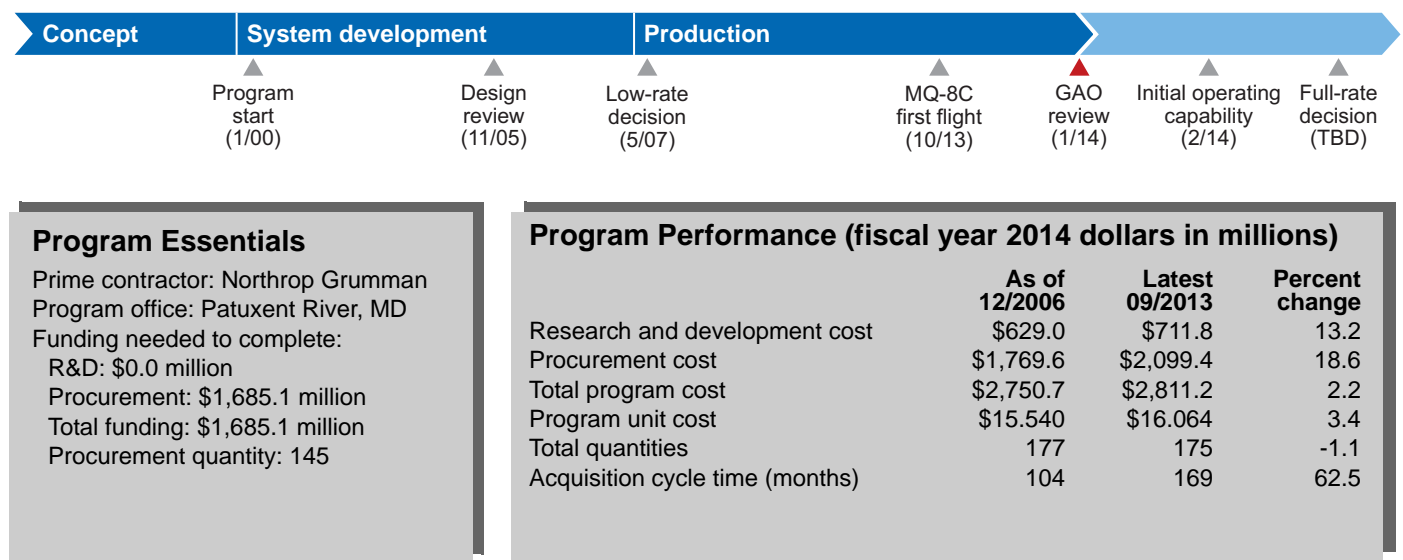
In addition to providing technical comments, the program office noted that the Triton UAS program continues to demonstrate success during its system development and demonstration phase as evidenced by the nine initial envelope expansion flights conducted to date. As reported in the December 2012 Selected Acquisition Report, the program breached the acquisition program baseline cost threshold for research, development, test and evaluation and the schedule thresholds for reaching production start, operational evaluation start, full rate production, and initial operational capability. The program has been re-planned to adjust the cost and schedule remaining for the system development and demonstration contract. A proposed program baseline revision is in work and all parameters will be reviewed, to include the operating and support cost estimate. The program continues to benefit from strong support within the Department of the Navy.

MQ-8 (Fire Scout)

The Navy's MQ-8 unmanned aerial vehicle is intended to provide real-time imagery and data in support of intelligence, surveillance, and reconnaissance missions. An MQ-8 system is comprised of up to three air vehicles with sensors, two ground control stations, and one recovery system. The air vehicle launches and lands vertically, and operates from ships and land. The MQ-8 is intended for use in various operations, including surface, anti-submarine, and mine warfare. We assessed the latest variant, the MQ-8C.



Source: Northrop Grumman Corporation.



The Navy ceased production of the MQ-8B variant and in April 2012 awarded a contract to begin development and production of the new MQ-8C with a larger airframe to improve range, endurance, payload, and future carrying capacity. MQ-8C relies on common, mature technologies with the MQ-8B. The engineering design of the MQ-8C is complete as it is based on the MQ-8B design, which appeared to be stable before halting production. The program completed operational test and evaluation of MQ-8B in December 2013 and a Quick Reaction Assessment of MQ-8C will be completed in the fourth quarter of fiscal year 2014. The program plans to conduct an acquisition strategy review in the first quarter of fiscal year 2014 that assesses overall program health, including production readiness. In 2015, the program plans to test the MQ-8C on the Littoral Combat Ship, the platform originally intended for MQ-8B.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	....
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

Fire Scout Program

Technology and Design Maturity

According to the program office, MQ-8C is 90 percent common with the previously developed MQ-8B, with the primary difference being structural modifications to accommodate the MQ-8C's larger airframe and fuel system. The MQ-8C relies on mature technologies common to the MQ-8B and does not introduce any new technologies. Program officials stated that the engineering design of MQ-8C is complete, as it is based on the MQ-8B design, which appeared to be stable prior to the Navy's decision to cease production of the system in 2012. Program officials noted that a revision to the air vehicle to accommodate increased payload remains to be completed, but they expect the issue to be resolved by early calendar year 2014. The first flight of the MQ-8C occurred in October 2013.

Production Maturity

The program plans to produce the MQ-8C on the same production line as the MQ-8B and officials stated that they have not experienced challenges in transitioning production between the systems. The program's production processes for MQ-8B have been demonstrated, but we could not assess whether critical manufacturing processes were in control as the program does not collect data on statistical process controls or assess process capabilities using manufacturing readiness levels. The program suspended production of MQ-8B and awarded a development and production contract for 8 MQ-8Cs in April 2012. The program earlier intended to resume production of the MQ-8B aircraft in 2015 to align with the delivery of the Littoral Combat Ship—the platform from which MQ-8B is intended to operate—but the Navy plans to continue MQ-8C production instead. The Navy plans to award a third production contract for MQ-8C in March 2014 in support of the Joint Emergent Operational Need. Program officials stated that the date of the full-rate production decision has not been determined. Future procurements will be addressed in the updated acquisition strategy.

Other Program Issues

The program has shifted its focus to MQ-8C—an upgraded variant of the aircraft with improved range, endurance, payload, and future carrying capacity—due to a joint urgent operational need from U.S. Africa Command. According to program

officials, the program is not requesting new funds for MQ-8C, but plans to use funding slated for MQ-8B. MQ-8C is not required to conform to many of the acquisition practices followed by other programs as it is being developed to fill a joint urgent operational need. However, a Quick Reaction Assessment is planned for MQ-8C 3 to 4 months prior to ship deployment, which is expected to be in the first quarter of fiscal year 2015. The program is planning to test the MQ-8C at-sea in 2014 on the DDG-109 and on the Littoral Combat Ship in 2015. The program completed operational test and evaluation of MQ-8B in December 2013 and a Quick Reaction Assessment of MQ-8C will be completed in the fourth quarter of fiscal year 2014. The program plans to conduct an acquisition strategy review in the first quarter of fiscal year 2014 that assesses overall program health, including production readiness.

Program Office Comments

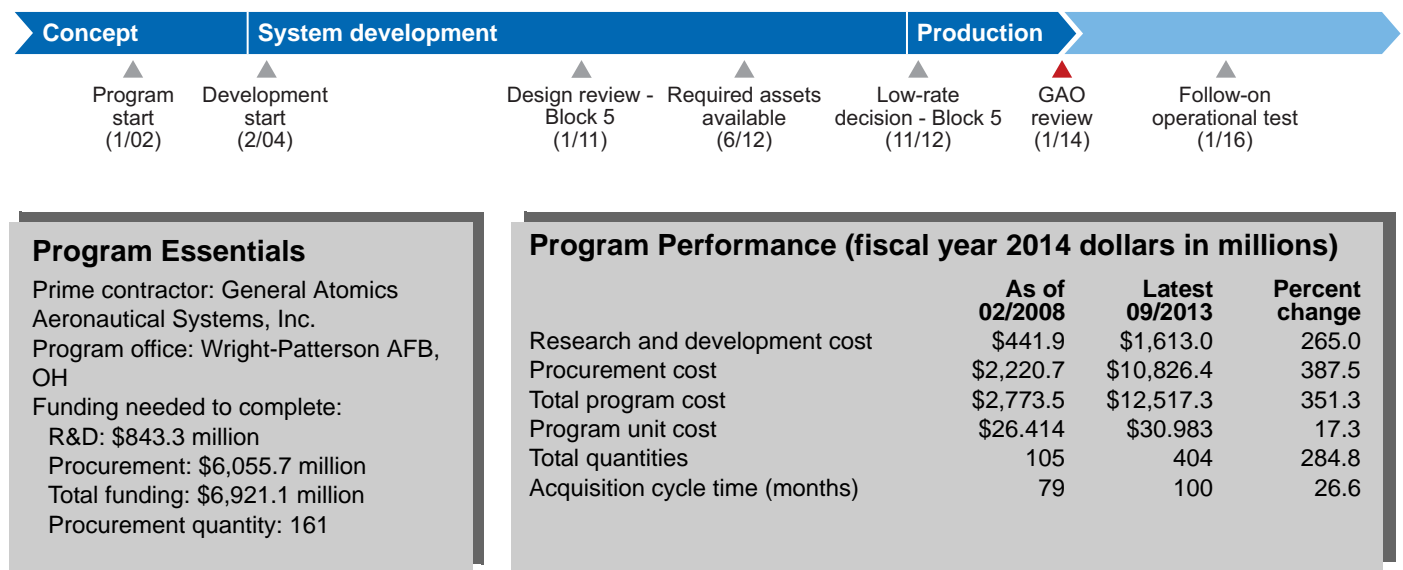
According to the program office, the MQ-8 Fire Scout system has accumulated over 4,500 flights totaling more than 12,000 flight hours with the MQ-8B air vehicle. In the first quarter of fiscal year 2014, the system was assessed by the Navy Operational Test community aboard USS Roberts and completed an Initial Operational Capability Supportability Review in preparation for fleet transition and Initial Operational Capability in second quarter fiscal year 2014. The Fire Scout system with the MQ-8C Endurance Upgrade aircraft is being procured in response to a Joint Emergent Operational Need from Africa Command. The Navy is planning to incorporate the MQ-8C variant into the Fire Scout system as part of its updated acquisition strategy. First flight of the MQ-8C occurred on October 31, 2013. As of January 2014, the MQ-8C has performed more than 32 test flights and accumulated over 46 flight hours. In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

MQ-9 Reaper Unmanned Aircraft System (MQ-9 Reaper)

The Air Force's MQ-9 Reaper is a multirole, medium-to-high-altitude endurance unmanned aircraft system capable of flying at higher speeds and altitudes than its predecessor, the MQ-1 Predator A. The Reaper is designed to provide a ground-attack capability to find, fix, track, target, engage, and assess small ground mobile or fixed targets. Each system consists of four aircraft, a ground control station, and a satellite communications suite. We assessed the increment I Block 5 configuration and made observations on Block 1.



Source: U.S. Air Force.



The Reaper's critical technologies are mature and all design drawings have been released. Delays in manufacturing, delivery of technical data, and developmental testing have pushed back critical software releases for both Block 1 and Block 5 configurations. The MQ-9 Reaper was approved for low-rate initial production in November 2012, but has not yet demonstrated that critical manufacturing processes are in control. The program originally expected to complete operational testing no later than October 2014; however manufacturing and other delays have caused the program to postpone the completion of testing until January 2016. The program's full-rate production decision was changed to an in-process review because more than half of the aircraft will be procured prior to a full-rate production decision.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

MQ-9 Reaper Program

Technology and Design Maturity

The Reaper's critical technologies are considered mature and its design is stable. Manufacturing issues, as well as delays in the delivery of technical data and developmental testing have pushed back critical Block 1 and Block 5 configuration software releases by 8 months and 15 months, respectively. Program officials now plan to field the Block 5 software in March 2016. The Block 5 configurations include capability enhancements from the Block 1 configuration such as updates to the radar, data link, sensor, landing gear, software, and ground control stations. Until testing is completed, the Block 5 system remains at risk of design changes.

Production Maturity

The Air Force approved low-rate initial production of the MQ-9 Reaper Block 5 Increment in November 2012. According to program officials, the Block 5 manufacturing processes have reached the level of maturity recommended by DOD guidance for the start of low-rate production. However, the program's manufacturing readiness level did not indicate that its production processes were in statistical control, as recommended by our best practices. MQ-9 Reaper production deliveries have slowed over the past year because of delinquencies in completing technical data, software delays, and fuel tank issues that required engineering design changes to the production line and retrofitting aircraft that had already been produced. As of December 2013, 21 Block 1 aircraft have been produced, but are still awaiting the necessary software capability upgrades before they can be delivered. Until these software upgrades are complete, aircraft are only being delivered based on urgent needs. According to program officials, the program has developed an aircraft delivery recovery plan that should allow deliveries to be back on track by April 2014.

Other Program Issues

The program office declared a breach to the MQ-9 Block 5 program's schedule baseline in May 2013 because of delays associated with manufacturing, technical data, and developmental testing. The program originally expected to complete operational testing no later than October 2014. Operational testing will now be complete in January 2016. This schedule change was approved by the configuration steering board in December 2013. At this time, the

full-rate production decision was changed to an in-process review since more than half of the aircraft will be procured prior to the full rate production decision. The program office is in the process of updating the acquisition program baseline.

Program Office Comments

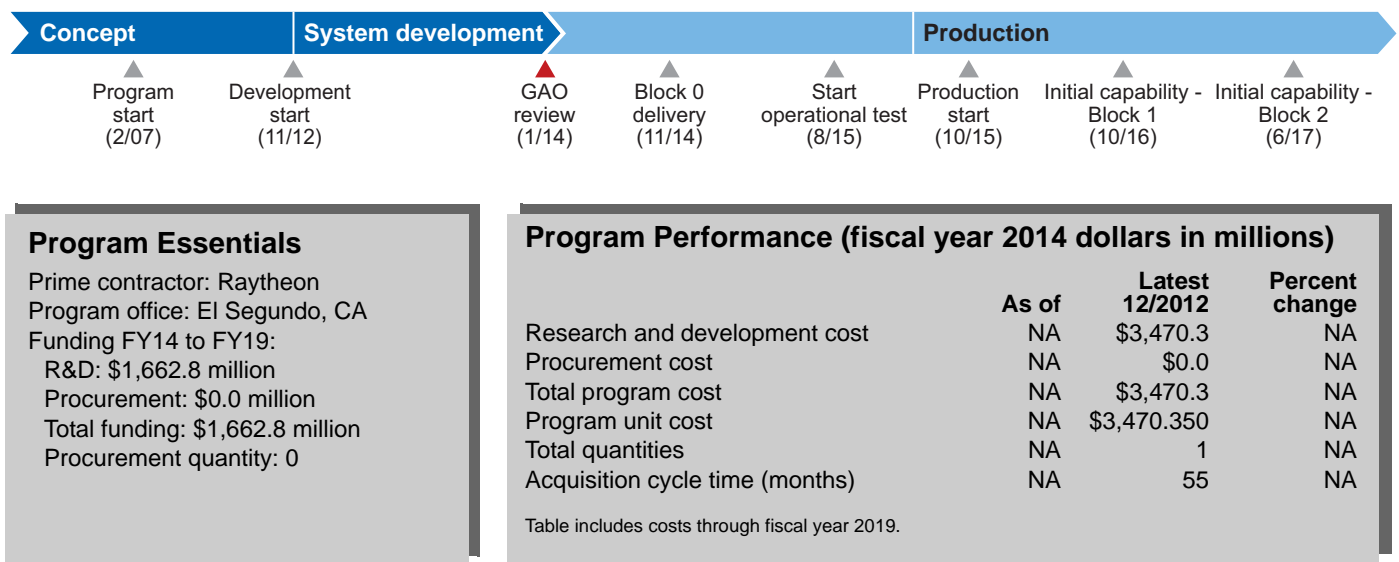
In commenting on a draft of this assessment, program officials noted that since the program office declared a breach in May 2013, the program office and contractor resolved issues that delayed schedule and are implementing processes to improve quality for future success. The re-baselined MQ-9 Block 5 schedule was approved at the Air Force review board in August 2013 and the configuration steering board in December 2013. The program office is updating the acquisition program baseline to reflect program changes. Follow-on test and evaluation is now planned to complete in January 2016. The program office is currently in formal developmental test of Block 5. The program office also took delivery of the first Block 5 aircraft in November 2013 to assist with developmental test and technical order development. The program office also provided technical comments that were incorporated as appropriate.

Next Generation Operational Control System (GPS OCX)

The Air Force's Global Positioning System Next Generation Operational Control System (GPS OCX) is to replace the current ground control system for legacy and new GPS III satellites. GPS OCX is expected to ensure reliable and secure delivery of position and timing information to military and civilian users. The Air Force plans to develop GPS OCX in blocks, with each block delivering upgrades as they become available. We assessed the initial three blocks, which support the launch, checkout, and operation of GPS II and III satellites.



Source: U.S. Air Force.



GPS OCX entered system development in November 2012. The program consists of three blocks: Block 0, intended to support the launch and checkout of GPS III satellites; Block 1, designed for command and control of the GPS II and III satellites; and Block 2, which is expected to support, monitor, and control additional navigation signals. The program's 14 critical technologies are nearing maturity, but seven of those technologies are not expected to reach full maturity until the end of fiscal year 2015 or later, nearly 3 years after the program began system development. Aligning the schedules for GPS OCX and GPS III is a risk for both programs. Block 1 is scheduled to become operational by October 2016, 6 months after the date of GPS III's availability for launch.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

GPS OCX Program

Technology Maturity

GPS OCX entered system development in November 2012 with all of its 14 critical technologies tested in a relevant environment, but not a realistic environment. According to program officials, these technologies will not reach full maturity until the program integrates together all of the key subsystems and components and tests them in the factory. The first of these tests is scheduled to occur near the end of fiscal year 2014 and is expected to result in seven of the technologies reaching full maturity. The remaining seven technologies are not expected to reach full maturity until the end of fiscal year 2015 or later, nearly three years after the program began system development.

Design and Production Maturity

GPS OCX is primarily a software development program and is expected to provide capabilities in three block deliverables. Block 0 is intended to provide initial capability for launch control and checkout of GPS III satellites. Block 1 is designed to operate legacy and new GPS satellites, including new civilian signals, and Block 2 is expected to add operational control of new international and modernized military signals.

According to the program office, software is being developed and tested incrementally with a critical design review after each stage to ensure the design is stable. Software development for Block 0 is nearly complete and all remaining testing is scheduled for completion at the beginning of fiscal year 2015. The program has started development activities for Block 1, which program officials expect to be completed in October 2016.

Program officials expect to integrate the software and hardware components for all of Blocks 0 and 1 and test them as a prototype to ensure the system will work as intended. According to GAO's best practices, this integrated prototype test should occur before critical design review. However, program officials stated that the test will not happen until December 2015, 18 months after the final critical design review and ten months before Block 1 is scheduled to be complete. Program officials reported that they had used other knowledge-based practices to increase confidence in the stability of

the design such as identifying key product characteristics and establishing a reliability growth curve.

Other Program Issues

The program experienced significant schedule delays while in technology development. This, combined with the program's late start relative to GPS III, has resulted in considerable risk in aligning the schedules of GPS OCX and GPS III satellites. Block 1, which is to provide command and control for GPS III satellites on orbit, is not scheduled to become operational until October 2016, 6 months after the first GPS planned GPS III satellite is expected to be available for launch. Until Block 1 is operational, the GPS III satellite will have very limited capabilities and Air Force officials said they do not plan to launch a second GPS III satellite until that time.

Program Office Comments

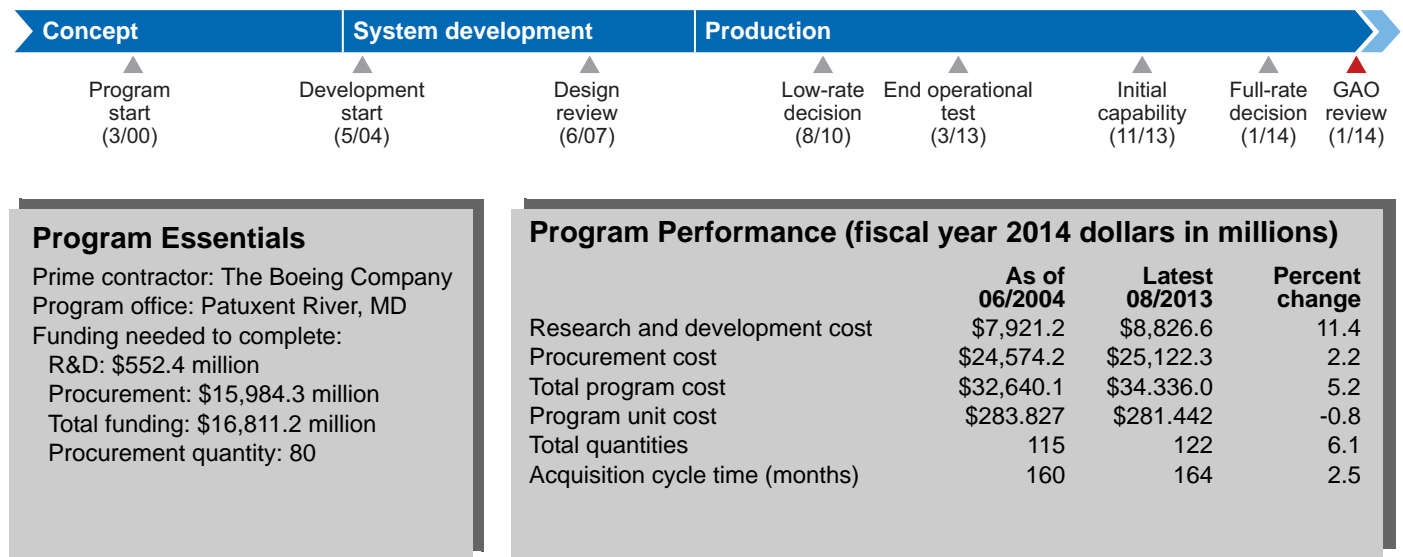
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated as appropriate.

P-8A Poseidon Multi-Mission Maritime Aircraft (P-8A)

The Navy's P-8A Poseidon is a commercial derivative aircraft that will replace the P-3C Orion. Its primary roles are antisubmarine warfare, antisurface warfare, and intelligence, surveillance, and reconnaissance. The P-8A is part of a family of systems, including the MQ-4C Triton unmanned aircraft system, which will perform maritime patrol missions and support the Navy's maritime warfighting capability. The program plans to field capabilities in three increments. We assessed increment one and made observations on increments two and three.



Source: U.S. Navy.



The P-8A entered production in August 2010 with mature technology, a stable design, and proven production processes. The P-8A completed initial operational testing in March 2013 and was found to be operationally suitable and effective. The test report identified five significant deficiencies and recommended that the P-8A be introduced to the fleet with several operational restrictions. According to the program office, it has plans in place to correct or otherwise resolve these deficiencies. The program's full rate production decision was delayed from July 2013 until January 2014 in part to enable additional assessment of deficiency corrections from developmental test and evaluation. To maintain production continuity, and utilize available funding, the program awarded a fourth low-rate production contract. The first P-8A operational deployment began in December 2013.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

P-8A Program

Technology Maturity

The P-8A entered production in August 2010 with a fully mature and sole critical technology, the hydro-carbon sensor. The sonobuoy launcher, which at one time was also considered a critical technology, has experienced issues in testing and fixes are still being made to improve its performance and reduce operator errors.

Design Maturity

Overall, the design of the P-8A is stable, but the number of design drawings continues to grow due to deficiencies discovered in testing. The number of releasable drawings increased by 16 percent since our last assessment and 95 percent of the total drawings have been released.

Production Maturity

The manufacturing processes for P-8A are mature and the program has improved the acceptance process after minor anomalies and maintenance issues were discovered with each of the first five production aircraft. According to program officials, Boeing has implemented additional pre-acceptance flights, which have reduced the number of issues discovered by the government during the formal acceptance process. More recently, the Defense Contract Management Agency reported the late delivery of spare parts could affect aircraft deliveries by reducing the program's ability to swap out defective parts when needed. The program office stated that it has addressed this issue and aircraft deliveries had not been impacted to date.

Other Program Issues

The P-8A program completed initial operational test and evaluation in March 2013. The final test report found the aircraft to be operationally effective and suitable. The report identified five significant deficiencies that are typically corrected before operational deployment and the operational test staff recommended that the P-8A enter the fleet with several operational restrictions. According to the program office, it has plans in place to correct or otherwise resolve these deficiencies. For example, to maintain main fuel tank temperatures within required operating limits during hot weather ground operations, the program is re-qualifying key components to higher operating limits and developing new planning tools and fueling

procedures. The first operational deployment of P-8A commenced in December 2013. Follow-on operational testing, which includes verifying test fixes discovered previously in developmental testing, began in October 2013.

The Navy delayed the program's full rate production decision from July 2013 until January 2014 in order to allow enough time for the program to assess deficiency corrections. To maintain production line continuity, and utilize available program funding, the program awarded a fourth low-rate initial production contract for 13 aircraft.

During increments 2 and 3, the program plans to integrate additional capabilities into the P-8A. Increment 2, which is being managed as a series of engineering changes rather than a separate development effort, includes various improvements to the system's antisubmarine warfare and other capabilities. The program eventually plans to retrofit previously manufactured aircraft with the planned Increment 2 capabilities. The Navy plans to conduct a separate system development phase for increment 3. The improvements include changes to the P-8A's system architecture to allow for rapid integration of new applications and services. The program plans to conduct full and open competition for its increment 3 contracts and to purchase the data rights for the new, more open architecture.

Program Office Comments

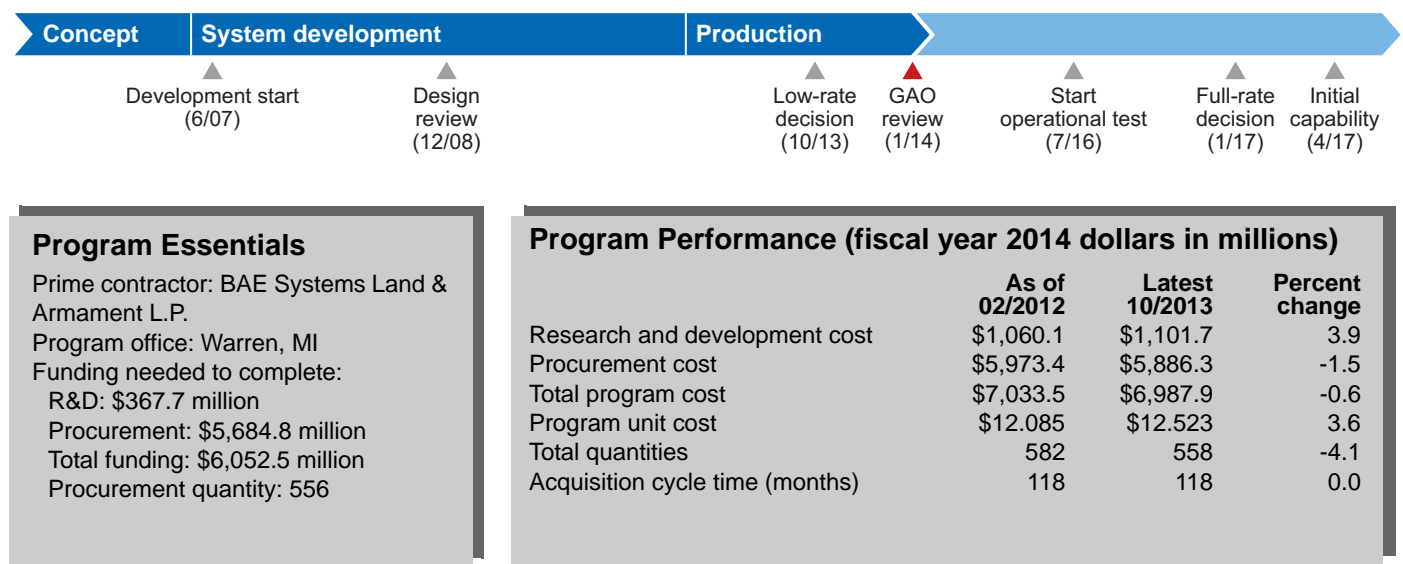
In commenting on a draft of this assessment, the program office stated that following an extensive operational test period, the Navy's operational test authority reported that the P-8A aircraft is operationally effective and suitable and recommended it for fleet introduction. The program office added that this conclusion is consistent with the fleet's experience with the aircraft during extensive aircraft transition and pre-deployment training cycles. The first such cycle began with the delivery of the first P-8A aircraft to an operational squadron in May 2012, included the attainment of initial operational capability in November 2013, and culminated with the departure of the first fully trained squadron for operational deployment later that same month. In December 2013, the thirteenth of 37 low-rate initial production aircraft was delivered to fleet squadrons, with all deliveries on or ahead of schedule. The program office also provided technical comments, which were incorporated as appropriate.

Paladin Integrated Management (PIM)

The Army's Paladin Integrated Management (PIM) system consists of two individual platforms, a self-propelled howitzer (SPH) and a tracked ammunition carrier that provides operational support. The SPH is a tracked, aluminum armored vehicle with a 155 millimeter cannon. The PIM will provide improved sustainability over the current Paladin M109A6 howitzer fleet through the incorporation of a newly designed hull; modified M2 Bradley infantry fighting vehicle power train, suspension system, and track; and a modernized electrical system.



Source: U.S. Army.



The program was approved for low-rate initial production in October 2013 with the first production delivery scheduled for March 2015. Program officials stated that a lack of available staff, staff furloughs, loss of workforce overtime, and a reduction in travel funding due to sequestration caused the production decision date to slip from June 2013 to October 2013. The program was approved for production with its two critical technologies fully mature and a stable design. The program, as originally structured, was not a major defense acquisition program, but was elevated to major defense acquisition program status due to rising cost estimates. The program has also experienced schedule slippage due to delays in the start of developmental testing and changes to force protection and survivability requirements that drove the addition of new armor kits and a new ballistic hull and turret.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	○
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

PIM Program

Technology Maturity

The program office identified two technologies critical to the PIM program; power pack integration and the ceramic bearing of the generator assembly. Both technologies have been assessed as fully mature. The program office identified these technologies as critical based on concerns about their performance at high temperatures. While neither technology is new or novel, failure of either would represent major program risk. In addition, increases in vehicle weight due to the addition of material to improve survivability, minimal power pack space, and other integration issues may degrade the ability to meet automotive performance requirements.

Design Maturity

According to the program office, the design is currently stable with all of the expected drawings released; however, the program faces a number of design challenges as it moves forward. The current contractor for the engine and transmission may cease production due to lack of orders. If this occurs, production with another vendor may be necessary and could result in a redesign of the engine and engine compartment. Production with another vendor has the potential for cost growth between \$32 to \$100 million and a significant schedule delay. Additionally, after the critical design review, the program manager identified a number of corrective actions, producibility, and obsolescence engineering changes to the PIM design that are scheduled to be implemented between low-rate initial production and initial operational test and evaluation. If significant issues are uncovered during the testing of these engineering changes, then there is potential for cost growth and delays in production.

Production Maturity

The program was approved for low-rate initial production in October 2013 with the first production vehicle scheduled for delivery in March 2015. As of August 2013, the program office indicated that a number of manufacturing processes and systems are below the maturity levels required by best practices. The program reported that the capability to produce the vehicles in a pilot-line environment will not be demonstrated until after production begins. Our best practices work has shown that

programs risk missing cost and schedule targets if their manufacturing processes are not demonstrated and in control before production begins. Program officials have indicated that there is a minimal risk that the PIM final assembly facility may not be ready in time to support initial PIM shipments.

Other Program Issues

The program's current plans are schedule driven, with limited time for correction of deficiencies identified in developmental testing and little flexibility with individual component test schedules. The program is waiting for low-rate initial production vehicles before verifying most corrective actions. Additionally, program officials stated that the PIM and the Bradley infantry fighting vehicle programs currently share a common path for the suspension and power train, but if the Bradley program diverges from this path there could be cost and schedule impacts for the PIM program.

Program Office Comments

In commenting on a draft of this assessment, the Army stated that the PIM program is on track for its full-rate decision scheduled for January 2017. Additionally, technical comments were provided, which were incorporated as appropriate.

Presidential Helicopter Fleet Replacement Program (VXX)

The Navy's VXX program is to provide a replacement helicopter fleet that will be used to transport the President, Vice President, heads of state, and others. As a successor to the terminated VH-71 program, the VXX fleet of 21 new helicopters will replace the current fleet of 19 VH-3D and VH-60N legacy helicopters and two training aircraft (to be delivered in 2014). The program plans to enter system development in March 2014. Until the VXX helicopters are available, the Navy is extending the availability of the legacy aircraft.



Source: U.S. Navy.



Program Essentials

Prime contractor: TBD
 Program office: Patuxent River, MD
 Funding FY14 to FY18:
 R&D: \$2,316.2 million
 Procurement: \$0.0 million
 Total funding: \$2,316.2 million
 Procurement quantity: 0

Program Performance (fiscal year 2014 dollars in millions)

	As of	Latest 11/2013	Percent change
Research and development cost	NA	\$2,532.0	NA
Procurement cost	NA	\$0.0	NA
Total program cost	NA	\$2,523.0	NA
Program unit cost	NA	TBD	NA
Total quantities	NA	23	NA
Acquisition cycle time (months)	NA	77	NA

Table includes costs through fiscal year 2018.

The Navy made progress in establishing a limited development effort that reflects trade-offs made among cost, schedule, risk, and performance. Since April 2012, the program completed its analysis of alternatives, in which affordability and cost control are key factors, finalized the requirements and acquisition strategy, and was granted a waiver to the competitive prototyping requirement. Program affordability and timeliness are achieved by maintaining a candidate platform's current airworthiness certification, leveraging mature technologies, and through Government definition of the mission systems architecture and related avionics. To minimize risk, a sub-system preliminary technical readiness assessment was conducted in February 2013. However, a system level preliminary design review has been deferred until after the March 2014 start of system development.

Attainment of Product Knowledge

Projected as of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ☐
- Demonstrate all critical technologies in a realistic environment ☐
- Complete preliminary design review ☐

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

VXX Program

Technology Maturity

The program reports the key technologies to be provided the government for integration into the VXX platform either already exist or are in development, some as legacy fleet aircraft upgrades. To minimize technical risk, the program completed a preliminary technical readiness assessment in February 2013; it was limited to the mission communication system (the only new technology envisioned for the VXX platform). As a result of this assessment, it was deemed the VXX mission communication system does not include any components that would be considered immature and classified as a critical technology element. Although the program has conducted a sub-system preliminary design review, it does not currently plan to conduct a preliminary design review until after the program enters system development. The statutory requirement for a preliminary design review has been waived, and will be conducted after the start of system development. To be consistent with the program's approved acquisition strategy, the language in the request for proposals encourages the use of mature off-the-shelf technologies that should only require standard engineering development practice to integrate and achieve installed systems performance.

Design Maturity

The VXX acquisition strategy is based on the integration of mature subsystems into an existing air vehicle. While minor changes to the platform, to accommodate integration of subsystems, are inevitable, change to major components such as drive train, rotors, engines and basic structure is highly discouraged. Any design elements that contain immature technology or that might be deemed a critical technology element are discouraged. The request for proposals encouraged offerors to remain within the existing airworthiness qualification of the baseline aircraft from which the VXX would be derived. The government does not intend to impose bottom-up airworthiness criteria that would drive redesign, but plans to leverage the current certification basis with the cognizant civil or U.S. military airworthiness certification authority to achieve a Naval Air Systems Command flight clearance.

Production Maturity

This program will leverage "green air vehicle" production by randomly selecting aircraft off the existing production line. This will save the government time and money by avoiding infrastructure costs associated with constructing a unique production facility and allow the program to meet its security production and supply requirements.

Other Program Issues

The program intends to award a single fixed-price type contract for the system development phase that will include options for low-rate initial production, full rate production, and associated logistics elements. The total aircraft quantity includes six aircraft to support system development, 17 production aircraft in three lots (six aircraft each in lot 1 and 2, and 5 in lot 3). The total period of performance will be approximately 8 years.

Program Office Comments

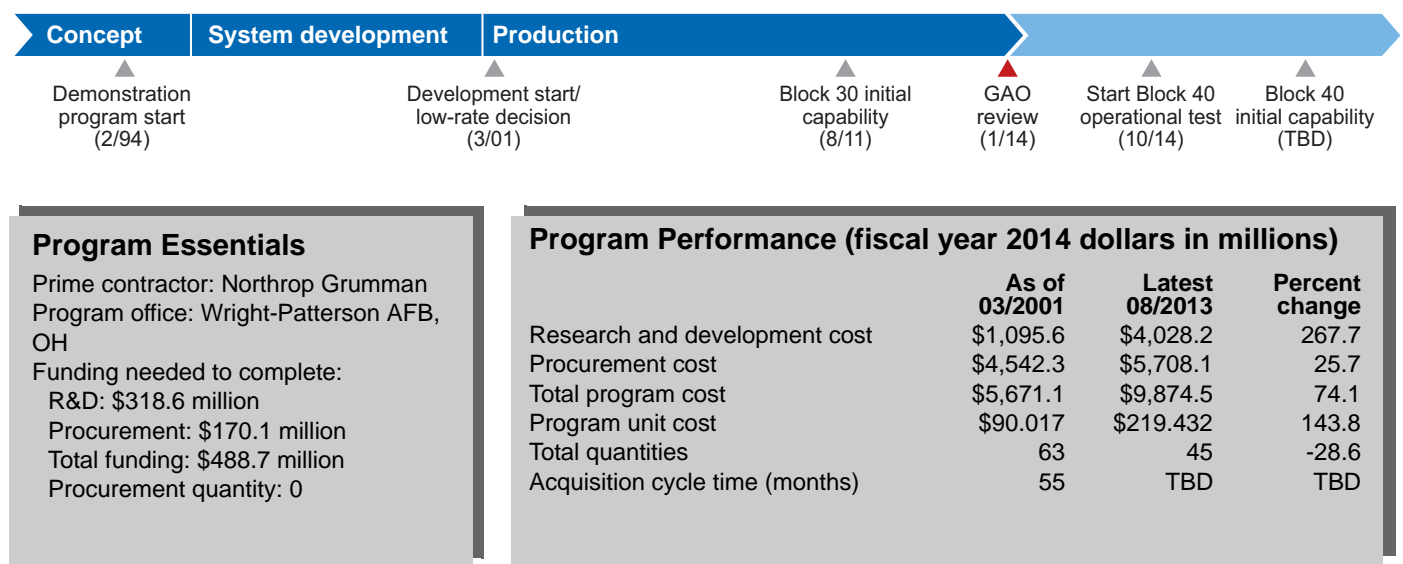
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

RQ-4A/B Global Hawk Unmanned Aircraft System (RQ-4A/B Global Hawk)

The Air Force's Global Hawk is a high-altitude, long-endurance unmanned aircraft that provides intelligence, surveillance, and reconnaissance capabilities. After a successful technology demonstration, the system entered development and limited production in March 2001. The early RQ-4A, similar to the original demonstrators, was retired in 2011, leaving a fleet of the larger and more capable RQ-4Bs, produced in three configurations—Block 20, 30, and 40.



Source: Northrop Grumman.



The Global Hawk program has mature technologies, a stable design, and mature manufacturing processes that are in statistical control. Congress directed the program to purchase the final three Block 30 aircraft and the program office awarded an advanced procurement contract in September 2013. All 45 Global Hawk aircraft have been purchased without a full-rate production decision. Congress directed the program to maintain the operational capability of Block 30 aircraft through December 2014. The Air Force will determine the final force structure following fiscal year 2015 and 2016 budget decisions. Block 40 aircraft operational testing has been delayed 6 months and delivery of a fully operational Block 40 capability has not been determined. The program fielded two Block 40 aircraft in September 2013, providing limited capability to the warfighter.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

RQ-4A/B UAS Global Hawk Program

Technology, Design, and Production Maturity

The critical technologies for the RQ-4B are mature, the basic airframe design is stable, and its manufacturing processes are mature and in statistical control. The RQ-4B aircraft consist of three configurations. Block 20 aircraft are equipped with an enhanced imagery intelligence payload, Block 30 aircraft have both imagery and signals intelligence payloads, and Block 40 aircraft have an advanced radar surveillance capability. The program is concurrently testing and fielding the multiple platform radar, the key capability for Block 40 aircraft. Due to software delays associated with another government system, Block 40 operational testing has slipped an additional 9 months, from January 2014 to October 2014, almost 4 years from the original estimate. Despite this, two Block 40 aircraft with the advanced radar capability were fielded in September 2013, providing a limited capability to the warfighter. Program officials stated that there is currently no formal date for the program to deliver a full capability Block 40 aircraft for operational use.

Other Program Issues

As part of its fiscal year 2013 budget request, DOD proposed terminating the Block 30 system in an effort to reduce program cost. However, in January 2013, Congress directed the Global Hawk program to purchase its remaining three planned Block 30 aircraft and mandated that the Air Force maintain the operational capability of Block 30 aircraft until December 31, 2014. The program reported that operating Block 30 aircraft beyond 2014 would create operational challenges and would require a substantial investment. According to officials, the Air Force will make a decision about the program force structure following future budget decisions. If the Air Force decides to retire Block 30 aircraft, almost half of all aircraft procured will be affected. In September 2013, the Air Force awarded an advanced procurement contract for the remaining three Block 30 aircraft and intends to award a firm fixed-price production contract in July 2014.

The Global Hawk program continues to operate without an established cost and schedule baseline, as its prior baseline was rescinded due to the program's Nunn-McCurdy breach in April 2011. The program had originally planned to re-establish its

baseline in June 2011, but that review was superseded by the Air Force's proposed termination of Block 30. Program officials stated they are working with the Office of the Secretary of Defense and the Air Force to establish a new baseline.

Production continues for Block 30 and Block 40 aircraft, despite the lack of an official full-rate production review. All 45 Global Hawk aircraft have been procured through low-rate initial production. The program does not plan to hold a production decision and, according to officials, continues to sustain operational aircraft.

The program had planned to begin development of a restructured ground control station and communications system to achieve a common architecture for both the Global Hawk and the Navy's Triton unmanned aircraft systems, has a similar design to Global Hawk. However, according to program officials the program could no longer afford the development effort due to fiscal constraints. Program officials noted that they have chosen to continue to maintain the current system and address obsolescence issues on an as-needed basis.

Program Office Comments

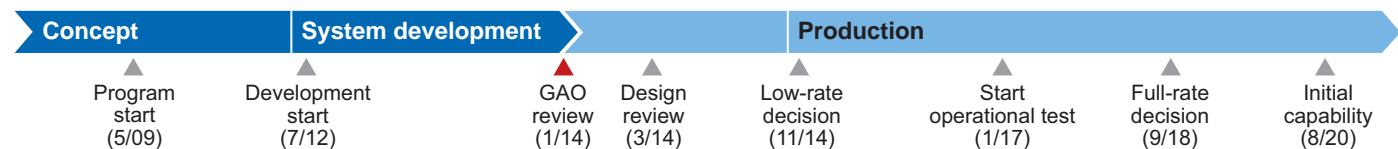
In commenting on a draft of this assessment, Air Force officials noted that the Air Force Operational Test and Evaluation Center completed the Block 40 operational utility evaluation in April 2013 in support of a Block 40 early operational capability. The two Block 40 aircraft that fielded in September 2013 were part of the early operational capability which provided the military with additional ground moving target support ahead of schedule. The Air Force also provided technical comments, which were incorporated as appropriate.

Ship to Shore Connector Amphibious Craft (SSC)

The Navy's SSC is an air-cushioned landing craft intended to transport personnel, weapon systems, equipment, and cargo from amphibious vessels to shore. SSC is the replacement for the Landing Craft, Air Cushion, which is approaching the end of its service life. The SSC is designed to deploy in Navy well deck amphibious ships, such as the LPD 17 class, and for use in assault and nonassault operations. The program entered system development in July 2012 and is scheduled for a critical design review in March 2014.



Source: U.S. Navy.



Program Essentials

Prime contractor: Textron Inc.
 Program office: Washington, DC
 Funding needed to complete:
 R&D: \$166.8 million
 Procurement: \$3,462.9 million
 Total funding: \$3,648.9 million
 Procurement quantity: 71

Program Performance (fiscal year 2014 dollars in millions)

	As of 07/2012	Latest 09/2013	Percent change
Research and development cost	\$585.4	\$571.2	-2.4
Procurement cost	\$3,552.6	\$3,462.9	-2.5
Total program cost	\$4,157.6	\$4,053.3	-2.5
Program unit cost	\$56.953	\$55.524	-2.5
Total quantities	73	73	0.0
Acquisition cycle time (months)	135	135	0.0

The SSC program entered system development in July 2012 with its one critical technology—the fire suppressant system—mature. Two other technologies designated as technology watch items leverage existing mature technologies, but will need to be modified for use on SSC. The program has completed approximately 5 percent of expected design drawings seven months prior to critical design review scheduled for March 2014. Fabrication for the first two craft is scheduled to start three months after the critical design review. The acquisition strategy identified the plan to construct the first two craft concurrently as a risk due to the potential for design changes.

Attainment of Product Knowledge

As of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment
- Demonstrate all critical technologies in a realistic environment
- Complete preliminary design review

Product design is stable

- Release at 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

.... Information not available
 Not applicable

SSC Program

Technology Maturity

The SSC program's one identified critical technology, the fire suppression system, entered system development as mature. According to program officials, the prime contractor is in the process of selecting a subcontractor to develop this system. According to the Navy, the system is expected to be lighter and more environmentally friendly than the system for the legacy craft.

DOD identified two other technologies—the gas turbine engine and the command, control, communications, computer and navigation (C4N) system—as critical technology watch-list items because of the possibility new technologies would need to be developed or modified for SSC. According to program officials, the gas turbine engine is mature, but needs modifications to convert it from aircraft to amphibious craft usage. In addition, program officials said that the prime contractor has selected a subcontractor to develop the C4N system and believes that the technology is low risk since it will leverage existing code from the legacy craft. Officials expect that the system will provide new operational features, including a pilot/co-pilot configuration that allows each operator to bring up the same display at separate consoles.

Design Maturity

As of August 2013, the contractor has released 42 of the 856 engineering drawings expected—almost 5 percent. Best practices suggest that completion of 90 percent of engineering drawing provides evidence of design stability. The program plans to demonstrate the stability of the SSC design at the program's production readiness review, currently planned for May 2014—2 months after the program's scheduled design review.

Fabrication of the first two craft are scheduled to begin in June 2014. The program office does not plan to assess critical manufacturing processes by the start of production. Program officials stated that they plan to have these processes partially demonstrated on a pilot production line before production start, noting that the program has pursued low risk technologies and a low risk design effort.

Production Maturity

The Navy plans to begin construction of the lead and follow-on craft concurrently—a strategy that has been identified as potentially risky due to the possibility that design changes identified in the first test and training craft would have to be incorporated in the second craft during construction. Despite this risk, the SSC program exercised an option to construct the second craft in December 2012—3 months earlier than planned. Program officials noted that the option was exercised earlier to take advantage of better pricing for certain long-lead construction materials. Overall, the program plans to exercise options for a total of six craft prior to delivery of the test and training craft in February 2017.

Program Office Comments

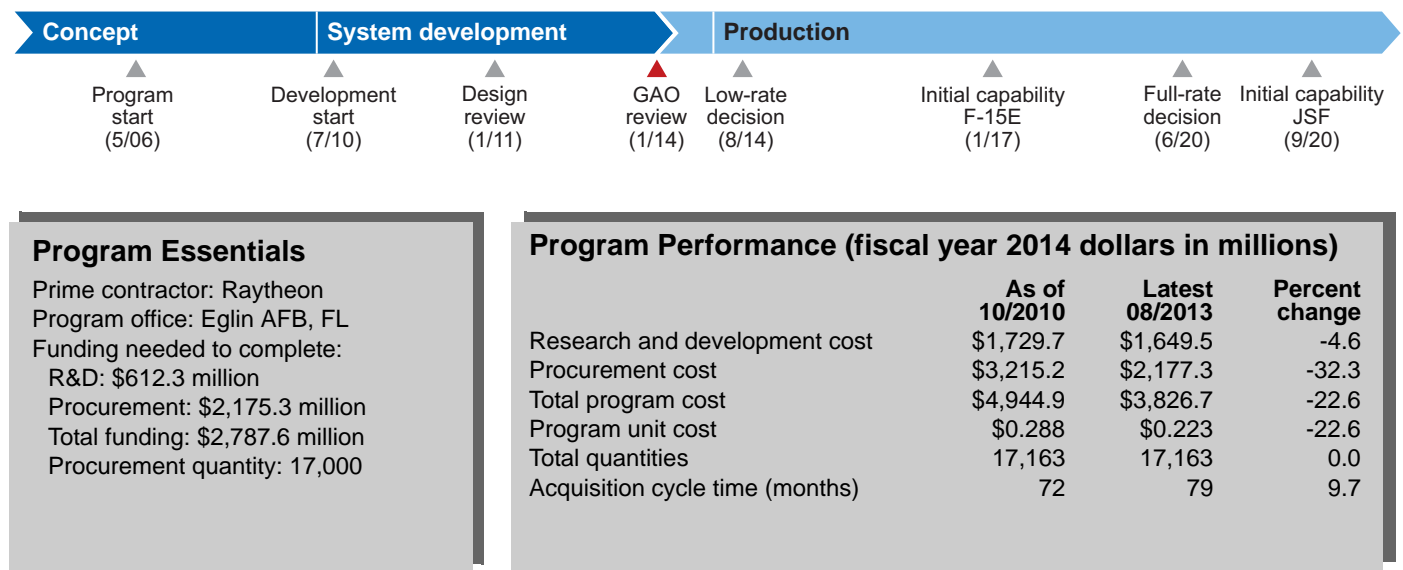
In commenting on a draft of this assessment, the program office noted that the Ship to Shore Connector is a technically mature, low risk program which is proceeding toward demonstration of design maturity. A detail design and construction contract was awarded in July 2012. The shipbuilder is conducting preliminary and critical design reviews of all major craft subsystems. The first craft's start of fabrication is planned for the third quarter of fiscal year 2014. The program office also provided technical comments which were incorporated where deemed appropriate.

Small Diameter Bomb Increment II (SDB II)

The Air Force's Small Diameter Bomb Increment II (SDB II) is designed to provide attack capability against mobile targets in adverse weather from standoff range. It combines radar, infrared, and semiactive laser sensors in a tri-mode seeker to acquire, track, and engage targets. It uses airborne and ground data links to update target locations as well as GPS and an inertial navigation system to ensure accuracy. SDB II will be integrated with F-15E, Joint Strike Fighter (JSF), F/A-18E/F, F-16C, and F-22A, as funding becomes available.



Source: © 2009 Raytheon Company.



The SDB II Program expects all of its critical technologies to reach full maturity by the time it enters low-rate production, which is planned to occur no earlier than August 2014—a 7-month delay from earlier estimates. The flight test program has experienced two failures, prompting a 6 month halt to flight testing in mid-2013. Since resuming flight test activities in October 2013, the program has conducted three successful flight tests. Although the design is stable, future design changes may be needed to address problems found in previous flight test failures. The flight test schedule is optimistic, requiring seven successful flight tests in 5 months. If additional flight test failures occur it could result in additional delays for the low-rate production decision.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

SDB II Program

Technology Maturity

SDB II's four critical technologies—guidance and control, multi-mode seeker, net ready data link, and payload—are scheduled to reach full maturity when the program has its low-rate production decision in August 2014, 4 years after the program entered system development. According to program officials, critical technologies have not directly contributed to any flight test failures.

Design Maturity

The number of design drawings is stable and the program has completed five successful guided flight tests. However, the flight test program experienced two failures that resulted in a 6-month halt in all guided test vehicle events until the program determined a root cause for the failures. The two failures were the result of the dome cover not deploying, preventing the seeker from acquiring the target, and a navigation error. Guided flight test activities resumed in October 2013 and, since then, the program has recorded three successful flight tests. Program officials stated that all of the failed tests have to be retested at a future date. Moreover, prior to the low-rate production decision, the program's test plan requires 11 successful flight tests, including two live fire events.

Production Maturity

The program's low-rate production decision is expected no earlier than August 2014, a 7-month slip due to a delay in the program's system verification review, a prerequisite for this decision. The verification review will evaluate all of the program's flight tests and the system qualification testing. Eleven of the 12 subsystems have successfully passed qualification testing. However, all up round environmental qualification testing has been on hold since September 2013 due to subsystem issues.

According to program officials, the seeker subsystem is the final subsystem to complete qualification. The subsystem qualification was halted for issues related to a leak in the warhead case and seeker encoders that failed during vibration testing. A correction has been identified for the encoders and will be incorporated before testing resumes. The all up round qualification program has been placed on hold until the leak in the warhead

case is resolved. The program has yet to identify a correction for the leak in the warhead. These delays have absorbed the entire 1-month qualification testing margin and contributed to the delayed system verification review, now scheduled for May 2014. According to program officials, the contractor will be adding additional vehicles to the all up round qualification program to lessen the effect that the pause has on the overall program schedule.

Other Program Issues

The program's test schedule prior to the low-rate production decision is optimistic. In addition to a 5-month delay in 2012, the test program recently ended a 6-month delay due to two flight test failures. According to program officials, the test program must have six successful flight tests prior to the May 2014 verification review. Additional flight test failures would likely further delay the low-rate production decision. Program officials also noted that future sequestration funding cuts may result in reduced production quantities or the inability to exercise contract options. This could force a renegotiation with the contractor for the first five production lots and the program could lose money that it saved through competition.

Program Office Comments

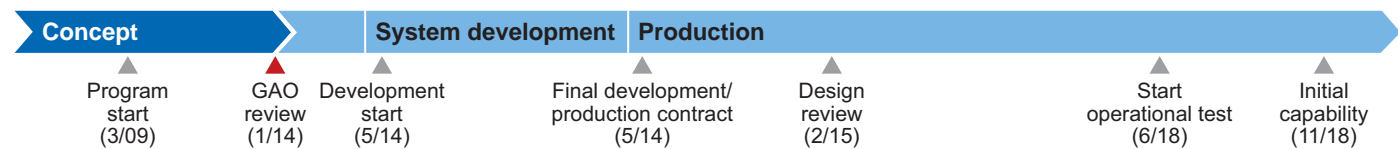
The Air Force concurred with this assessment. The Air Force also provided technical comments, which were incorporated as appropriate.

Space Fence

The Air Force's Space Fence program is developing a system of large ground-based radars that will replace the Air Force Space Surveillance System, which became operational in 1961 and was recently shut down. Space Fence will use higher radio frequencies to detect and track more and smaller earth-orbiting objects than is currently possible. The Air Force currently plans to award a contract for construction of one radar with an option for a second.



Source: U.S. Air Force.



Program Essentials

Prime contractor: TBD
 Program office: Hanscom AFB, MA
 Funding needed to complete:
 R&D: \$958.2 million
 Procurement: \$103.2 million
 Total funding: \$1,061.4 million
 Procurement quantity: 1

Program Performance (fiscal year 2014 dollars in millions)

	As of	Latest 10/2013	Percent change
Research and development cost	NA	\$1,565.2	NA
Procurement cost	NA	\$103.3	NA
Total program cost	NA	\$1,668.5	NA
Program unit cost	NA	\$1,668.463	NA
Total quantities	NA	1	NA
Acquisition cycle time (months)	NA	116	NA

The Space Fence program has seven critical technologies, which are expected to demonstrate full maturity during or after the critical design review. The program delayed development start and awarding of the system development contract to May 2014, a delay of almost 2 years. As a result, the program delayed initial operational capability by a year to November 2018. DOD budget reductions also led to the early shutdown of the Air Force Space Surveillance System, which was originally planned to be operational through Space Fence's initial operations. A new data processing system is being developed by the Air Force, separate from Space Fence, to accommodate the projected increase in the volume of data generated.

Attainment of Product Knowledge

Projected as of January 2014

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

Space Fence Program

Technology Maturity

All seven of the program's critical technologies are currently nearing full maturity and are not expected to demonstrate full maturity until the critical design review, scheduled for 9 months after development start, or later. According to program officials, the critical technologies are not particularly challenging advances in technology. The risk for the program is in deploying radars on the very large scale needed. The program's technology development phase included competitive development of two fully working prototypes by separate contractors to reduce program risk. If a second radar site is deemed necessary, the technologies used for that site may differ, depending on the final program design.

Design and Production Maturity

The contract for the final Space Fence system development contract has not yet been awarded, so the program does not have a final system design and thus we did not assess design or production maturity.

Other Program Issues

The Air Force plans to competitively award a single system development and production contract in May 2014. This date reflects the second significant delay to contract award from the original date of July 2012. The first delay was due to an internal DOD program review required before the contract proposal could be issued. The program office attributes the additional delay in awarding the contract and initiating development to the strategic choices management review, which looked at affordability of future acquisitions DOD-wide.

The Air Force plans to award a fixed-price incentive contract for system development activities for the first radar site, with a contract option for the second site. If the option for the second site is exercised, it is planned to be operational 36 months after the program meets initial operational capability. However, funding for the second site is uncertain, and it potentially may not be needed depending on whether the first site exceeds its design capability. Program officials stated that the decision on whether or not to build a second site will likely be made after the first site is operational. In addition,

the program has pushed back the anticipated initial operational capability date by more than a year, to 2018.

The Air Force Space Surveillance System, the legacy system that Space Fence will replace, ended operations in October 2013. The Air Force originally intended to keep that system functioning until Space Fence became operational. According to the Air Force, the decision to end operations early was made due to funding constraints caused by sequestration. Air Force officials said they have modified the operations of other space surveillance assets in a way that will maintain a roughly equivalent level of space surveillance until Space Fence is operational.

The Joint Space Operations Center (JSpOC) at Vandenberg AFB is acquiring a new data processing capability—JSpOC Mission System (JMS)—to process the increased volume of data expected from Space Fence. JMS is being developed through a separate acquisition program and, according to Space Fence program officials, is required to process the amount of data Space Fence is expected to generate. Currently, JMS is scheduled to become operational by December 2016, enabling input and processing of data from Space Fence in time for its initial operational capability.

Program Office Comments

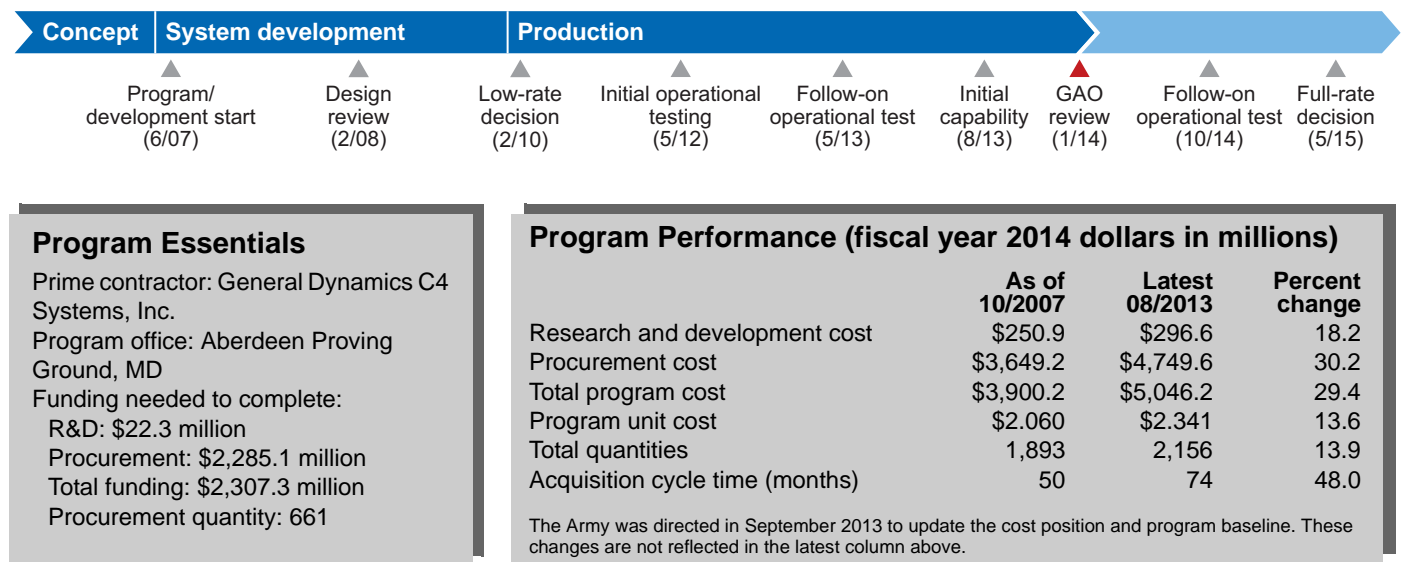
In commenting on a draft of this assessment, the program office noted that the Office of the Secretary of Defense chose to delay the Space Fence system development certification in light of the strategic choices Management review outcomes. The Air Force amended the Space Fence request for proposals issued in November 2013. This amendment reflects the change to the initial operational capability delivery date, specified as 56 months after contract award (first quarter fiscal year 2019), as well as a full operational capability date, specified as 36 months after initial operational capability (first quarter fiscal year 2022). It also reflects an update to the total projected budget to more closely reflect the current fiscal reality. Having resumed source selection, award of a single fixed price incentive contract is expected in the third quarter of fiscal year 2014. The program also provided technical comments, which were incorporated where appropriate.

Warfighter Information Network-Tactical Increment 2 (WIN-T Inc 2)

WIN-T is the Army's high-speed and high-capacity backbone communications network. It connects units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a March 2007 Nunn-McCurdy unit-cost breach of the critical threshold, and will be fielded in four increments. We assessed the second increment, which is expected to provide the Army with an initial networking on-the-move capability.



Source: U.S. Army.



WIN-T Increment 2 entered production in February 2010 with mature critical technologies and, according to program office metrics, a stable design, but before bringing manufacturing processes under control. A recent assessment of the program's manufacturing readiness levels indicates that these processes are now demonstrated and under control as the program approaches full rate production. However, during its May 2012 initial operational test, the program did not demonstrate required performance and reliability. A follow-on operational test in May 2013 showed improved reliability and performance but revealed that deficiencies remain. Consequently, the milestone decision authority has delayed the full rate production decision until the Army completes an additional follow-on operational test and confirms that deficiencies have been corrected.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	....
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	....
• Test a production-representative prototype	●
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

WIN-T Increment 2 Program

Technology Maturity

All 15 WIN-T Increment 2 critical technologies were mature by its February 2010 production decision. In August 2012, an independent manufacturing readiness assessment prepared by the Army concluded that the prime contractor had achieved an acceptable level of technology maturity to continue to full rate production.

Design Maturity

According to the WIN-T program, it has integrated and tested its key technologies and subsystems to demonstrate that the system's design is capable of working as intended. The program office does not track the metric we use to measure design maturity—the number of releasable drawings—as WIN-T is primarily an information technology integration effort. Instead, design performance is measured through a series of component, subsystem, configuration item, and network-level tests designed to demonstrate performance at increasing levels of system integration. Design stability is measured through problem-tracking report trends.

Production Maturity

The WIN-T Increment 2 program began production in February 2010 and began testing a production-representative prototype 13 months later in March 2011. The program indicates that its manufacturing processes—as determined by an Army manufacturing readiness assessment—are now in control, but had not yet been demonstrated or brought in control at production start. During its May 2012 initial operational test, the program did not demonstrate required performance and reliability. A follow-on operational test in May 2013 showed improved reliability and performance but revealed that deficiencies remain. In particular, three of the program's nine configuration items were assessed as not operationally effective and two were not operationally suitable due to complexity of operations and reliability problems. In addition, the program demonstrated cyber security vulnerabilities that need improvement. Consequently, the milestone decision authority has delayed a full rate production decision until the Army completes an additional follow-on operational test in November 2014 as part of the Army's Network Integration

Evaluation 15.1 that confirms that deficiencies have been corrected. A full-rate production decision is planned for May 2015.

Other Program Issues

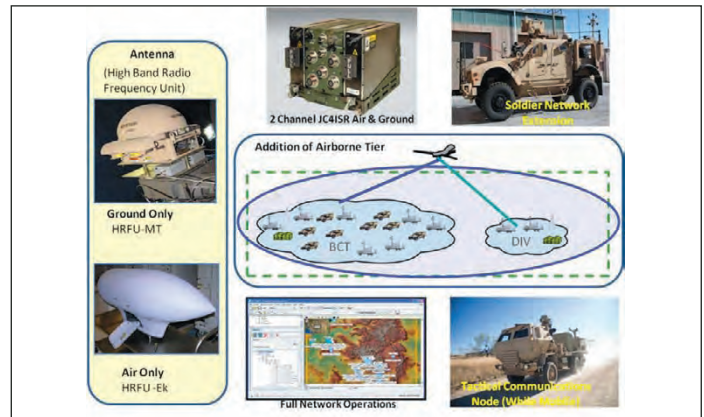
While the milestone decision authority has not yet approved a full-rate production decision, the Army declared that the program attained its initial capability in August 2013. This decision was based on the Army's assertion that initial operational capability was reached when the first brigade combat team and its division headquarters was equipped and fully trained with the new equipment and the follow on operational test had been successfully completed. However, as noted above, the May 2013 follow-on operational test revealed deficiencies with the program that must be corrected and these corrections must be confirmed during an additional follow-on operational test.

Program Office Comments

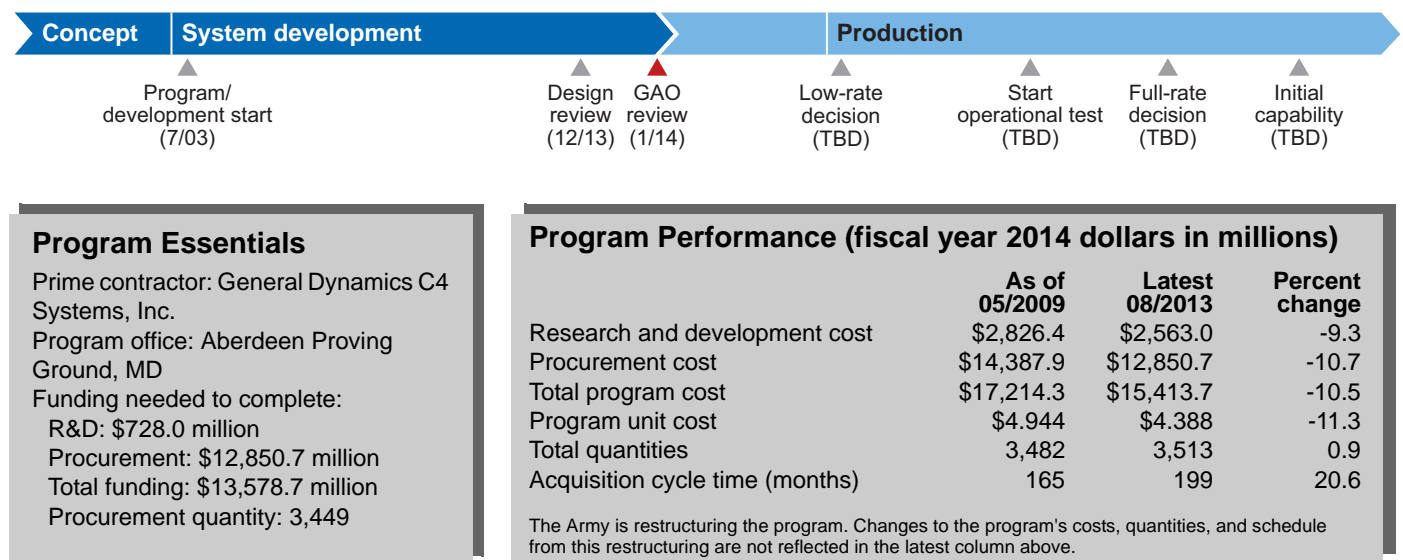
In commenting on a draft of this assessment, the Army noted that in September 2013, it received approval from the Defense Acquisition Board for an additional low-rate initial production lot and an acceptance to field existing lots of WIN-T Increment 2. The Army has fielded five Brigade Combat Teams and two divisions, and remains on track to field Capability Set 14 to units, including Stryker Brigade Combat Teams. Using soldier feedback from theater and test results, the Army intends to continue to improve WIN-T Increment 2 capabilities with the primary focus being on simplifying the operations and maintenance of the equipment. The program office also provided technical comments, which were incorporated where deemed appropriate.

Warfighter Information Network-Tactical Increment 3 (WIN-T Inc 3)

WIN-T is the Army's high-speed and high-capacity backbone communications network. It connects units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a March 2007 Nunn-McCurdy unit-cost breach of the critical threshold, and will be fielded in four increments. We assessed the third increment, which is expected to provide the Army a full networking on-the-move capability.



Source: U.S. Army.



According to an Army representative, 12 of WIN-T Increment 3's 18 current critical technologies are mature and 6 are nearing maturity following the critical design review of the program in December 2013. However, the program is being restructured based on the recommendations of a configuration steering board held in November 2013. This restructuring could affect the program's need for certain critical technologies. The program does not use the number of design drawings released or alternative methods to assess design stability. However, the program plans to begin capturing software design stability metrics once a baseline system design is established.

Attainment of Product Knowledge	
As of January 2014	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	....
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	.... Information not available
○ Knowledge not attained	Not applicable

WIN-T Increment 3 Program

Technology Maturity

According to an Army representative, 12 of the program's 18 current critical technologies are mature, and 6 are nearing maturity following the critical design review of the program in December 2013. However, in January 2014 the Army acquisition executive directed the program executive officer with oversight of the WIN-T Increment 3 program to restructure the program based on the recommendations of the Army's configuration steering board.

The program's restructuring could affect its need for certain critical technologies. For example, the Army's configuration steering board has recommended descopeing the air tier from the program. According to an Army representative, the program will need to complete a follow-on critical design review once it has been restructured, at which point the critical technologies will need to be reassessed.

Design Maturity

The program does not use the number of design drawings released or any alternative methods to assess design stability. According to the program office, the number of design drawings is not meaningful as WIN-T is not a manufacturing effort, but a software development and hardware integration effort. The program asserts that it has appropriate software metrics and tracks design stability through its configuration management software production plan.

Other Program Issues

According to an Army representative, the Army is in the process of conducting a "network capability" review to determine the "right mix" of tactical networking capabilities to provide to brigade combat teams. In addition, the program is awaiting the final assessments from the Army's recently completed configuration steering board. These two events will factor into the scope of the restructured program. According to an Army representative, restructuring considerations may include maximizing the use of the capabilities currently being fielded under the WIN-T Increment 2 program while maintaining focus on WIN-T Increment 3 network operations efforts and balancing affordability, as DOD and the Army face long-term budgetary challenges.

Program Office Comments

In commenting on a draft of this assessment, the Army noted that as of early 2014, the WIN-T Increment 3 program is anticipating a final program assessment from the Department following the program's critical design review and is also awaiting Department's approval of a program transition strategy based on the WIN-T Increment 3 configuration steering board meeting held in November 2013. These events, coupled with ongoing Army tactical network capability review decisions, will provide guidance on the scope of the program's effort going forward.

Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)

The Army's AMF JTRS program plans to acquire two non-developmental software-defined radios, the Small Airborne Link 16 Terminal (SALT) and the Small Airborne Networking Radio (SANR), and associated equipment for integration into Army rotary wing and unmanned aerial systems. Previously, the program had been developing software-defined radios and associated equipment for integration into nearly 160 different types of aircraft, ships, and fixed stations to increase communications and networking capabilities.



Source: U.S. Army.

Current Status

The Under Secretary of Defense for Acquisition, Technology, and Logistics, in July 2012, restructured the AMF JTRS program due to concerns about the potential for unbounded cost increases, and continued schedule and contractor performance risk. Market research also determined that non-developmental items could be modified to meet users' revised needs and priorities. The Under Secretary also transferred responsibility for program management to the Army. While the use of a non-developmental item approach will likely reduce some technical risk, the Army will need to manage the integration of government-developed waveforms into the non-developmental item radios and the radios into various platforms.

AMF JTRS now plans to acquire two non-developmental software-defined radios. The SALT is designed to be a 2-channel radio capable of running the Link 16 waveform and the Soldier Radio Waveform (SRW). The program plans to introduce production hardware into the Apache AH-64E assembly line in fiscal year 2016. Until then, according to program officials, the Apache program office is pursuing an interim solution, the Small Tactical Terminal (STT), which will run only Link 16. The Army acquisition strategy for SALT calls for full and open competition. The Army plans to release the SALT request for proposals in the second quarter of fiscal year 2014 and a full rate production decision is scheduled for fiscal year 2016.

The SANR is designed as a 2-channel radio capable of running the SRW, Single Channel Ground and Airborne Radio System waveform, and the Wideband Networking Waveform. The SANR acquisition strategy plans a full and open competition to select two contractors for SANR test assets. A low rate initial production decision is scheduled for fiscal year 2016 and full rate production is scheduled for fiscal year 2018.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: \$3,582.7 million
 Research and development: \$1,849.3 million
 Procurement: \$1,733.4 million
 Quantity: 15,652 channels

Next Major Program Event: SALT full-rate production and SANR low-rate initial production decisions in first quarter 2016.

Program Office Comments: The program office concurred with the assessment.

Amphibious Combat Vehicle (ACV)

The Marine Corps' ACV is intended to transport troops from ship to shore and secure a beachhead. The Marine Corps has a requirement to replace the existing amphibious assault vehicle (AAV) but the Secretary of Defense terminated the initial effort, the Expeditionary Fighting Vehicle (EFV) program, in January 2011 due to technology problems, development delays, and cost increases.



Source: U.S. Marine Corps.

Current Status

A December 2011 materiel development decision memorandum directed that a "highly tailored" approach be used to acquire the ACV and that this effort focus on a cost-effective solution, emphasizing engineering and design analysis through establishment of affordability targets. According to officials, the Marine Corps completed an ACV analysis of alternatives (AOA) in July 2012 and the Navy forwarded it to the Office of the Secretary of Defense. According to ACV program officials, although high-water speed had been a primary requirement for the EFV, it was not part of the initial ACV AOA study. Instead, the study was based on a speed requirement that was about half of the EFV's, which would make the ACV a "displacement" vehicle more similar in water speed to the AAV. Marine Corps leadership subsequently directed that the affordability of a high-water speed amphibious vehicle be studied before the ACV began acquisition. This feasibility analysis is ongoing.

Officials reported that the Marine Corps is studying trade-offs in ACV capability to find the ACV design that will provide improvements in amphibious capability-speed, range, lethality, and survivability-over the current amphibious vehicle at an affordable cost. They added that, following the feasibility analysis, the Marine Corps Commandant will make a decision on whether the ACV acquisition program will formally begin at technology development or system development. Expectations are that the ACV will not reach initial operating capability before 2023. To address the delay in fielding an amphibious vehicle to replace the legacy AAVs, 392 current AAVs will undergo survivability upgrades that will address deficiencies in survivability.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: TBD

Research and development (fiscal years 2012-2017): \$1,047.1 million

Procurement: TBD

Acquisition related operation and maintenance (fiscal years 2012-2017): \$18.9 million

Quantity: TBD

Next Major Program Event: System development start, TBD

Program Office Comments: The Marine Corps was provided a draft of this assessment and did not offer any comments.

Armored Multi-Purpose Vehicle (AMPV)

The Army's Armored Multi-Purpose Vehicle (AMPV) fleet is the proposed replacement to the M113 family of vehicles in the armored brigade combat team. The AMPV will replace the M113 in five mission roles: general purpose, medical evacuation, medical treatment, mortar carrier, and mission command. The Army has determined that development of the AMPV is necessary due to mobility deficiencies identified in the M113, as well as space, weight, power and cooling limitations that prevent the incorporation of future technologies.



Source: U.S. Army.

Current Status

Based on direction at the August and November 2013 defense acquisition board reviews, AMPV's acquisition strategy was updated and approved before a request for proposals was released in November 2013. The program's acquisition strategy is based on modifying an existing platform and bypasses the technology development phase to begin in system development. The program is still working to define key technologies, and as a result, will require potential contractors to include data related to the technology maturity of their design in each proposal. AMPV's acquisition strategy also calls for selection of a single contractor for system development, and provides for three low-rate initial production options within the system development contract. The program currently plans to award a cost plus incentive fee contract for system development with a fixed price incentive option for low-rate initial production. The AMPV contract will include engineering and manufacturing development and low-rate initial production incentives for cost and reliability.

Procurement of AMPV, with an estimated total acquisition cost of up to \$10.2 billion, will occur at about the same time as the Army's Joint Light Tactical Vehicle program. The procurement of these programs is expected to continue for a decade or more.

Estimated Total Program Cost and Quantity (fiscal year 2014 dollars)

Total Program: \$10,223 million
 Research and development: \$779.9 million
 Procurement: \$9,443.0 million
 Quantity: 2,907

Next Major Program Event: Start of system development, first quarter fiscal year 2015

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

B-2 Defensive Management System Modernization (B-2 DMS)

The Air Force's B-2 DMS modernization program is expected to upgrade the aircraft's analog defensive management system to a digital capability to detect, identify and avoid threats. The modernization is intended to update pilot displays and enhance the in-flight capability to avoid unanticipated air defense threats. Improvement in frequency coverage, sensitivity of the electronic warfare suite, and reliability and maintainability are also anticipated. The latter is expected to improve the B-2's readiness rate.



Source: U.S. Air Force.

Current Status

In October 2012, the program entered a second technology development phase, which continued throughout 2013. The program had scheduled a preliminary design review prior to beginning system development in April 2014, but officials told us they are currently restructuring the program due to expected future budget reductions. Program documentation indicates moderate technical risk due to the program's schedule and nuclear hardening activities. Also, the antenna design, the software schedule, and the availability of test aircraft are risk areas. Early in the program, an independent assessment identified six critical technologies; however, currently the program does not believe any critical technologies exist. Another independent technology readiness assessment, scheduled prior to system development, will identify the final list of critical technologies.

We have previously reported that the program was implementing a rapid acquisition initiative to reduce its acquisition time by up to 3 years and lower costs by as much as \$500 million. To achieve these results, several activities were planned including: early software prototyping, reducing the time required for flight testing, and improving antenna installation times. By conducting these activities, it was anticipated the program might take 7 years to complete and cost \$1.58 billion. While some parts of the initiative have yielded positive results, including a subcontractor competition for antenna development that officials told us saved time and money, the program's start of development, flight testing, and full operational capability have all been delayed. The program now expects to complete acquisition in almost 9 years at a cost of over \$2 billion, which means most of the expected reductions in cost and schedule from the initiative will not be realized.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: \$2,036 million
Research and development: \$1,385 million
Procurement: \$651 million
Quantity: 20

Next Major Program Event: System development start, April 2014

Program Office Comments: In commenting on a draft of this assessment, DOD officials told us the assessment is accurate based on the fiscal year 2014 budget. They added that the B-2 DMS modernization program remains the top B-2 modernization priority. The program office also provided technical comments which were incorporated as appropriate.

Combat Rescue Helicopter (CRH)

The Air Force's Combat Rescue Helicopter (CRH) program, formerly called HH-60 Recapitalization, is an effort to replace aging HH-60G Pave Hawk helicopters. The CRH's primary mission is to recover personnel from hostile or denied territory; it will also conduct humanitarian, civil search and rescue, disaster relief, and non-combatant evacuation missions. The program is the second effort to replace the HH-60G. The first, the Combat Search and Rescue Replacement Vehicle (CSAR-X), was canceled because of cost concerns in 2009.



Source: 2013 Sikorsky Aircraft Corp. Used with permission for support of CRH.

Current Status

The Air Force expects that the CRH will be an existing helicopter with modifications to integrate mature technology subsystems and associated software. The CRH program received its materiel development decision in March 2012 and DOD authorized the program to bypass technology development and enter the acquisition process at system development. The program successfully completed a defense acquisition board review in September 2012 which approved its acquisition strategy and release of a request for proposals for a full and open competition in October 2012. Depending upon the availability of future funding, the CRH program office plans to enter system development in March 2014, delayed from the originally scheduled August 2013. The program is preparing to then award a fixed price incentive firm target development contract to Sikorsky, which was the only contractor who responded to the request for proposals. However, the program does not intend to conduct any systems engineering technical reviews until after the development contract is awarded. According to officials from the Office of the Secretary of Defense, the program was granted a waiver in late 2012 to conduct its preliminary design review after the start of system development, as well as a waiver for the requirement to conduct competitive prototyping. In our previous work, we have found that acquisition programs which successfully complete robust systems engineering early in the acquisition process and conduct a preliminary design review prior to starting system development typically have better outcomes. Initial operational capability for the helicopter is expected in the fourth quarter of fiscal year 2019.

Estimated Total Program Cost (fiscal year 2014 dollars):

Total program: TBD

Research and development (fiscal years 2012-2018): \$1,310.9 million

Procurement (fiscal years 2016-2018): \$ 2,187.7 million

Military construction: TBD

Acquisition operations and maintenance: TBD

Total quantity: 112

Next Major Program Event: System development start, March 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Common Infrared Countermeasure (CIRCUM)

The Army's CIRCUM, the next generation of the Advanced Threat Infrared Countermeasures (ATIRCUM), will be used with a missile warning system and a countermeasure dispenser capable of employing expendables, such as flares and chaff, to defend aircraft from infrared-guided missiles. The CIRCUM program will develop a laser-based countermeasure system for rotary-wing, tilt-rotor, and small fixed-wing aircraft across DOD. CIRCUM is one of three subprograms that make up the ATIRCUM/CMWS major defense acquisition program.



Sources: © 2011 BAE Systems (left); Northrop Grumman (right)

Current Status

The CIRCUM program began in 2009 when the Under Secretary of Defense for Acquisition, Technology and Logistics supported the Army's decision to restructure the ATIRCUM/CMWS program. In June 2009, the Army received approval to award five contracts to provide prototype systems for testing. After testing these prototypes, the Army concluded that the systems were not mature enough for entry into system development. The Army subsequently decided that the program should proceed with a technology development phase that will include additional prototyping efforts to further mature CIRCUM technologies and awarded two contracts in January 2012.

The Army held preliminary design reviews in July and August, 2013 with both contractors. The review report stated that the system's preliminary design satisfies the operational and suitability requirements. Also, the Army recently conducted a preliminary technology readiness assessment based on contractor testing in which nine critical technology elements were identified and are approaching full maturity leading up to system development. A final technology readiness assessment will be conducted prior to development to verify technology and design maturity and will be based on government-witnessed testing.

In October 2013, the two CIRCUM contractors completed prototypes deliveries. According to the Army, both designs are mature and are low risk of not meeting the specified requirements even with the current configurations. The Army plans to make a system development decision in December 2014 and plans to award one contractor a cost plus fixed fee/firm fixed price contract with technical performance incentives focused on achievement of weight and reliability goals.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total Program: \$3,599.8 million

Research and development: \$788.8 million

Procurement: \$2,811.0 million

Quantity: 1,076

Next Major Program Event: System development start, December 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

DDG 51 Destroyer (DDG 51)

The DDG 51 destroyer is a multimission ship designed to operate against air, surface, and subsurface threats. After a nearly 4-year break, the Navy restarted Flight IIA production and plans to buy at least nine ships between fiscal years 2013 and 2017. The Navy plans to procure three Flight III ships, a modification of the Flight IIA design, beginning in fiscal year 2016. Flight III is expected to have an increased focus on missile defense and will include the Air and Missile Defense Radar (AMDR), initially an S-band radar developed under a separate program.



Source: Bath Iron Works.

Current Status

Four DDG 51 Flight IIA ships are under construction and an additional nine ships are under contract. The design of the Flight IIA ships will be modified to include an upgraded Aegis combat system currently being developed. The Navy will also replace the existing SPS-67 radar with SPQ-9B, currently installed on several Navy ships, beginning in fiscal year 2014. The Navy believes that it has largely resolved issues with production of a new reduction gear.

DDG 51 Flight III ships are expected to feature new electric plants, new air-conditioning plants, and the AMDR. According to the Navy, the new electric plants are based on a design used on DDG 1000 and modification will be required for integration with DDG 51. The DDG 1000 electrical system has faced delays in completing testing. Detail design work for Flight III will begin at the end of fiscal year 2014, according to the Navy. Adding AMDR to DDG 51 will result in a significant redesign of the ship and the Navy expects that Flight III will result in changes to more than 25 percent of Flight IIA drawings, although the Navy believes many of these will be minor alterations. The Navy will need AMDR's design assumptions, such as its size, shape, weight, and power and cooling requirements in order to accurately redesign the ship. However, the Navy only recently awarded a contract for AMDR system development and the AMDR program is at least 6 months behind schedule. Based on its current schedule, the Navy plans to begin detail design work for Flight III at the end of fiscal year 2014—before AMDR has demonstrated full maturity—adding risk and uncertainty to the DDG 51 program.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program (fiscal years 2010 to 2018): \$23,089.5 million

Research and development (fiscal years 2010 to 2018): \$900 million

Procurement (fiscal years 2010 to 2018): \$22,189.6 million

Quantity: 15

Next Major Program Event: Defense acquisition board review of Flight III modifications, third quarter fiscal year 2014.

Program Office Comments: According to program officials, the Flight III schedule integrates all equipment development efforts into the overall ship detail design effort. This is the same process successfully implemented on previous flight upgrades. Due to the AMDR technology development phase, which produced working 1000-element arrays, the current design maturity supports commencement of detail design. Flight III is on track to be implemented on the second fiscal year 2016 ship.

F-15 Eagle Passive/Active Warning and Survivability System (F-15 EPAWSS)

The Air Force's F-15 EPAWSS program is intended to upgrade the electronic warfare system on fielded F-15 aircraft. The program seeks to improve the aircraft's internal self-protection electronic warfare systems to enable operations in current and future threat environments. The program is also expected to improve the F-15's survivability by enhancing its ability to detect, identify, locate, deny, degrade, disrupt, and defeat air and ground threat systems.



Source: U.S. Air Force.

Current Status

In November 2012, the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics approved the Air Force's plans to conduct an analysis of alternatives and to award a pre-engineering and manufacturing development characterization contract for the F-15 EPAWSS program, which occurred in fiscal year 2013. The Air Force plans to leverage non-developmental electronic warfare technologies and components, currently used in other Air Force and Navy aircraft, to create a state-of-the-art wide bandwidth digital electronic warfare system capable of protecting the F-15 aircraft against advanced enemy threats. The Air Force is currently updating the program's requirements documentation and intends to conduct a preliminary design review before starting system development in fiscal year 2016. The program office plans to award a production contract in fiscal year 2018.

An early Air Force assessment of F-15 EPAWSS identified digital receiver technology—both the hardware and the associated software—as a critical technology that the program does not intend to fully mature prior to the start of system development. According to program officials, a key risk is integration of the electronic warfare system with all other on-board and off-board systems, so that it operates properly in its intended operational environment. The program expects to add future capabilities as new electronic warfare threats emerge.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: TBD

Research and development: \$614.9 million (fiscal years 2014 to 2018)

Procurement: TBD

Quantity: 392

Next Major Program Event: Defense acquisition board review of acquisition strategy, February 2014

Program Office Comments: According to the Air Force, the program office continues to refine the planning for the F-15 EPAWSS program based on in-work requirements documentation and final acquisition strategy approval by the Milestone Decision Authority.

Ground Combat Vehicle (GCV)

The Ground Combat Vehicle (GCV) is an incremental program to replace segments of the Army's combat vehicle inventory. The first variant is intended to be the service's next infantry fighting vehicle, replacing a portion of the current M2 Bradley fleet. The Army expects GCV to provide a full-spectrum capability to perform offensive, defensive, stability, and support operations; carry a nine-soldier squad; emphasize force protection; and be operational within 7 years of beginning technology development.



Source: U.S. Army.

Current Status

In August 2011, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved GCV's entry into technology development. The Army awarded contracts to two contractor teams, but resolving a bid protest prevented the start of technology development until December 2011. Since then, the Army has been involved in three activities: updating the analysis of alternatives, assessing upgrades to existing vehicles, and funding two contractors' efforts to build and demonstrate key subsystem prototypes.

On January 16, 2013, the Under Secretary directed a number of changes to the program, including extending the technology development phase six months, delaying both system development and production, and directing that a single prime contractor be selected for system development. These actions provide significant reductions to the funding necessary to execute the program.

An independent review team identified three candidate critical technologies—all nearing full maturity—that could be incorporated into the GCV design. The program will continue monitoring these technologies and consider their maturity and risk as part of the full and open competition planned for system development. Since our last report, both contractors continued technology development by maturing preliminary designs and subsystems, completing multiple tests of their respective mine blast protection designs, and testing engines and drive trains. After holding preliminary design reviews to determine whether the proposed designs could satisfy requirements, a defense acquisition board will determine the program's readiness to proceed into system development, which is expected to begin in June 2014. The Army plans to begin procuring GCV while simultaneously procuring other new and costly combat vehicles including the Joint Light Tactical Vehicle.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: \$29,219.6 million

Research and development: \$4,968.5 million

Procurement: \$24,229.1 million

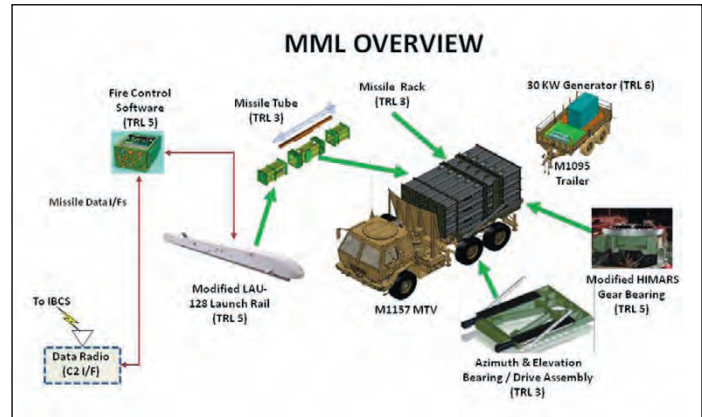
Quantity: 12 (development), 1,874 (procurement)

Next Major Program Event: System development start, June 2014

Program Office Comments: According to officials in the office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, the GCV program was cancelled on the order of the Secretary of Defense.

Indirect Fire Protection Capability-Increment 2 (IFPC Inc 2)

The Army's IFPC Increment 2 consists of three blocks, each a separate major defense acquisition program, to detect, assess, and defend against threats from rockets, artillery, mortars, cruise missiles, and unmanned aircraft. The first IFPC increment, fielded in 2004, provides a short-range capability to counter rockets, artillery, and mortar threats. IFPC Increment 2, Block 1 establishes the capability to counter cruise missiles and unmanned aircraft. The remaining blocks add to and extend the range and capability.



Source: U.S. Army.

Current Status

In 2004, after the first increment of IFPC was fielded, users developed a new requirement to counter unmanned aircraft and cruise missiles. The Surface Launched Advanced Medium-Range Air-to-Air Missile was originally set to fulfill this requirement, but was cancelled. To replace it, in 2011, the Army proposed a new interceptor, launcher, and radar. The \$1.6 billion estimate for developing this new system, however, was deemed unaffordable. The Army then proposed a three block alternative, each a separate major defense acquisition program, which leverages an existing interceptor and sensor and competitively awards the development of a new launcher. Block 1 is scheduled for fielding in fiscal year 2019. The review to begin technology development for Block 1 was held October 22, 2013, but final approval is pending until January 2014 due to budget concerns, including sequestration, according to officials. Program officials noted that the most significant risk is integration with the existing systems being leveraged, such as the AIM 9 Class Interceptor and the Sentinel radar. Successful integration is necessary to avoid increased costs or overall failure to meet requirements. According to program officials, the program is reusing existing technologies to promote affordability and using open systems architecture for the launcher to enable it to work with a variety of current and future missiles. Blocks 2 and 3 are scheduled to begin development in fiscal years 2019 and 2027, respectively.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

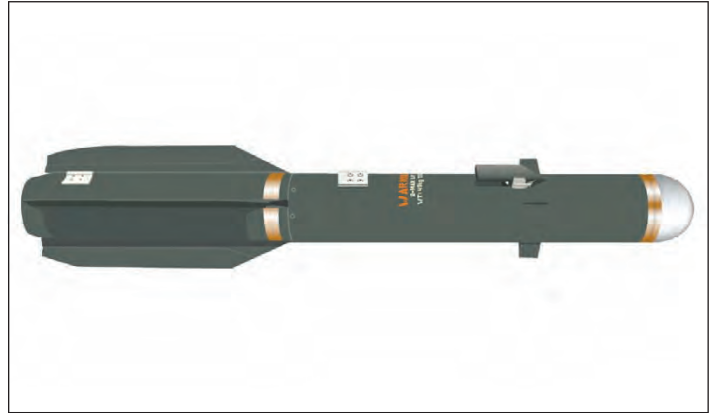
Total program: \$2.5 billion
 Research and development: \$510 million
 Procurement: \$2.0 billion
 Quantity: 5 (development), 344 (procurement)

Next Major Program Event: System requirement review, January 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Joint Air-to-Ground Missile (JAGM)

The Joint Air-to-Ground missile is an Army-led program with joint requirements from the Navy and Marine Corps. The missile is designed to be air-launched from helicopters and unmanned aircraft systems to target tanks; light armored vehicles; missile launchers; command, control, and communications vehicles; bunkers; and buildings. It is intended to provide line-of-sight and beyond line-of-sight capabilities and deploy in a fire-and-forget mode or a precision attack mode. JAGM will replace all variants of HELLFIRE missiles.



Source: U.S. Army.

Current Status

In early 2012, the Army restructured JAGM extending technology development by more than 2 years to explore evolutionary alternatives to the acquisition strategy, refine requirements and explore a more affordable solution. In August and November 2012, the Army awarded letter contracts to Lockheed Martin and Raytheon for this extended technology development. Program officials stated that these efforts focus on the guidance section, the key technology that provides the capabilities required by the Army, Marine Corps, and Navy. Preliminary design reviews of each contractor's design were held in February and April 2013, respectively.

The Assistant Secretary of the Army for Acquisition, Technology, and Logistics conducted a program status review informed by the preliminary design reviews to assess the program's cost, schedule, and performance risk. Based on funding shortfalls of \$36 million and findings of the risk assessment, in August 2013, the Assistant Secretary of the Army for Acquisition, Technology, and Logistics directed the JAGM program to execute the continued technology development phase with a single contractor in order to meet technology development objectives on schedule. According to program officials, Raytheon's technical performance was not on track to meet program goals or Army requirements. As a result, the government did not award a follow-on contract to extend performance after April 2013. Lockheed Martin will continue with technology development under their existing contract. Upon completion of all objectives and technology development exit criteria, approval of the acquisition strategy, and completion of the source selection evaluation board, the Army is planning for a system development decision in fiscal year 2015. The acquisition strategy will allow for a competitive contract award for system development.

Estimated Total Program Cost and Quantity (fiscal year 2014 dollars):

Total Program: TBD

Research and development (fiscal years 2008-2018): \$656.4 million

Procurement (fiscal years 2008 to 2018): \$116.8 million

Quantity: 167

Next Major Program Event: Subcomponent critical design review, January 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

The Army's JLENS is designed to provide elevated, persistent, over-the-horizon surveillance and fire control quality data enabling protection of U.S. and coalition forces and critical assets. A JLENS orbit consists of two systems: a fire control radar system and a surveillance radar system. Each system is comprised of a 74-meter tethered aerostat, a mobile mooring station, communication and processing stations, and ground support equipment. The program was restructured following a Nunn-McCurdy unit-cost breach of the critical threshold.



Source: U.S. Army.

Current Status

In August 2013, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved the program's revised acquisition program baseline, re-designated the program's acquisition category and delegated milestone decision authority to the Secretary of the Army. The JLENS program satisfied developmental testing and evaluation requirements and is proceeding with plans to execute a 3-year operational combatant command exercise. The exercise is expected to demonstrate JLENS capabilities for homeland defense and inform a future decision for enduring operational employment.

The program reported that recent operational test events at the Utah Test and Training Range and at the White Sands Missile Range demonstrate that JLENS performs as expected. Phase two of the second early user test—which assessed system performance and reliability and allowed for soldier training on system configuration—was successfully completed in June 2013, and, according to program officials, eliminated the need for the third series of developmental tests. Integrated fire control testing occurred in July 2013 and demonstrated JLENS capabilities in acquiring, tracking and providing sensor track data. The program will need to complete "friend or foe" identification system and communication link certification events before it can participate in the exercise. Site construction for the deployment of the exercise will begin at Aberdeen Proving Ground after the February 2014 construction contract award. The construction will involve completing aerostat pads, roads, operation and support facilities, and infrastructure. The initial system is expected to arrive at the exercise site location in June 2014 and initial capability delivery is expected for the surveillance radar in September 2014 and the fire control radar system in December 2014.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: \$2,782.12 million

Research and development: \$2,741.61 million

Military construction: \$40.51 million

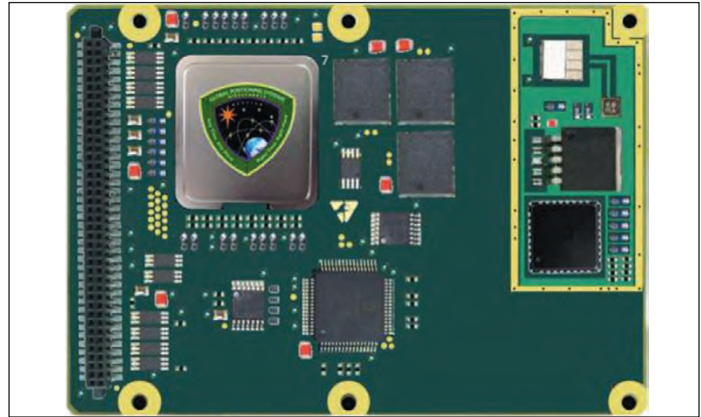
Quantity: 2

Next Major Program Event: February 2014 construction contract award for exercise site construction.

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Military GPS User Equipment (MGUE), Increment 1

The Air Force's MGUE program plans to develop GPS receivers compatible with the military's next-generation GPS signal, Military-Code. The modernized receivers are to provide U.S. forces with enhanced position, navigation, and time capabilities, while improving resistance to existing and emerging threats, such as jamming. The program is to be completed in two increments. Increment 1, assessed here, leverages technologies from the Modernized User Equipment (MUE) program to develop two variants and begin development of the Common GPS Module.



Source: U.S. Air Force.

Current Status

In April 2012, the Air Force initiated technology development for Increment 1 of MGUE. According to the Air Force, all five critical technologies identified by the Office of the Secretary of Defense—military-code acquisition engine, military-code cryptography, selective availability/anti-spoofing module cryptography, anti-spoofing, and anti-tamper—are currently nearing maturity. The Air Force plans to develop two variants—one each for ground and aviation, as Navy officials believe the aviation variant can support maritime needs. The current approved Increment 1 program leverages technologies from the Modernized User Equipment program to develop two variants and begin development of the Common GPS Module. Increment 2 is not yet approved.

The program's preliminary design review has been delayed 5 months, to June 2014. According to officials, the delay was caused by two factors: sequestration of fiscal year 2013 MGUE funding, which forced the program to limit contractor activity, and a new initiative to reduce complexity within the cryptography required to encrypt and decrypt communications. In last year's assessment, the program reported two main risk areas, ensuring more than one contractor meets design requirements for the application specific integrated circuit (ASIC)—a vital component leveraged from MUE—and software development. According to Air Force officials, progress in manufacturing and testing the ASIC as well as the complexity reduction effort has largely addressed these risk areas. However, the program identified a new risk in obtaining security certification to field GPS receivers in unclassified environments. According to officials, however, neither the delay in the preliminary design review nor the risk areas is expected to delay the program's entry into system development, scheduled for November 2014.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: TBD

Research and development: \$1,658.0 million

Procurement: TBD

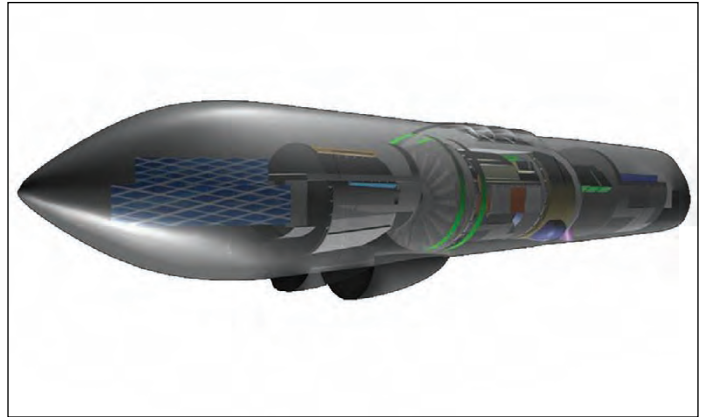
Quantity: 124 (development), 550 (production)

Next Major Program Event: Preliminary design review, April 2014

Program Office Comments: In commenting on a draft of this assessment, the Air Force affirmed that it continues to strive to field military-code GPS receivers as quickly as possible. The service has leveraged previous technology and industry experience to mitigate risk and reduce cost, and seeks additional opportunities to streamline the MGUE acquisition. The program office also provided technical comments, which have been incorporated where appropriate.

Next Generation Jammer (NGJ)

The Navy's Next Generation Jammer (NGJ) is being developed as an external jamming pod system fitted on carrier-based EA-18G Growler aircraft. It will replace the ALQ-99 jamming pod system and provide enhanced airborne electronic attack capabilities to disrupt and degrade enemy air defense and ground communication systems. The Navy plans to field capabilities in three increments for different radio frequency ranges beginning with Increment 1 (mid-band) in 2020 with Increments 2 and 3 (low- and high-band) to follow. We assessed Increment 1.



Source: U.S. Navy.

Current Status

In July 2013, DOD approved NGJ Increment 1's entry into technology development; however, work was delayed when GAO sustained a protest related to the technology development contract award. Prior to technology development, the Navy completed a 33-month technology maturation phase, during which the Navy selected four contractors to prototype key technologies and subsystems related to their proposed NGJ Increment 1 concept. According to program officials, each contractor chose the technologies to prototype during technology maturation, but they generally aligned with five critical technology areas—power generation and distribution, exciters, beam formers, amplifiers, and apertures. DOD believes that these prototyping activities meet the competitive prototyping requirements of the Weapon Systems Acquisition Reform Act of 2009, which require competitive prototyping for MDAPs before system development unless a waiver is granted. The program office stated it is also planning to use open systems architecture to enhance future competitions and to provide flexibility for upgrades.

Following technology maturation, the Navy awarded a single \$280 million contract to Raytheon for technology development with plans to award a sole-source follow-on contract to complete system development for Increment 1. In October 2011, the Navy stated that it expected to save about \$641 million by using only one contractor for technology development. In November 2013, GAO sustained portions of BAE Systems' protest of the contract award and recommended that the Navy document a reevaluation of the proposals and a cost/technical tradeoff analysis. In January 2014, the Navy reaffirmed Raytheon's contract award and resumed NGJ's technology development efforts after a 6-month delay, but faces a \$100 million funding reduction.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: \$6,336.3 million

Research and development: \$2,894.6 million

Procurement: \$3,442.7 million

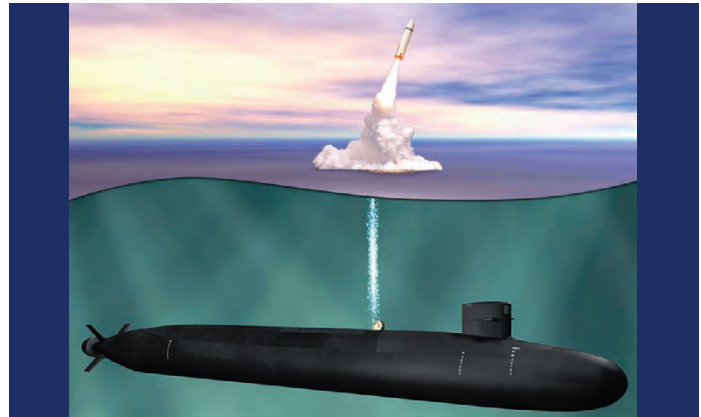
Quantity: 9 (development), 114 (procurement)

Next Major Program Event: System development start, second quarter fiscal year 2016

Program Office Comments: The NGJ program office provided technical comments, which were incorporated as appropriate. The Navy is reviewing its schedule to identify actions to maintain its fiscal year 2020 fielding date for NGJ Increment 1.

Ohio-Class Replacement (OR)

The Navy's *Ohio*-class Replacement (OR) will replace the current fleet of *Ohio*-class ballistic missile submarines (SSBNs) as they begin to retire in 2027. The Navy began technology development in January 2011 in order to avoid a gap in sea based nuclear deterrence between the *Ohio*-class's retirement and the production of a replacement. The Navy is working with the United Kingdom to develop a common missile compartment for use on OR and the United Kingdom's replacement SSBN. OR will initially carry the Trident II D5LE missile.



Source: © 2012 General Dynamics Electric Boat.

Current Status

Navy officials stated that they are pursuing design for affordability initiatives and investigating various contracting and acquisition scenarios to reduce average follow-on ship procurement costs from an estimated \$5.6 to \$4.9 billion (in fiscal year 2010 dollars). The program intends to maximize economic order quantity benefits by leveraging the *Virginia*-class program and the elements common with the United Kingdom's SSBN. Program officials stated the OR and *Virginia*-class programs are aligned to support various contracting scenarios, including procuring the lead OR concurrently in a multi-year procurement with the Block V *Virginia*-class contract. The Navy would develop a legislative proposal in 2017 to support this approach. The lead ship would likely not meet multi-year procurement criteria that require a stable design that has typically completed initial operational test and evaluation. The Navy has set initial configurations for areas including the torpedo room, bow, and stern. In 2014, the program expects to complete initial specifications, set ship length—a major milestone—and start detailed system descriptions and arrangements. The contractor plans to build a notional submarine section to validate the fidelity of its new design tool. The program plans to have 83 percent of design disclosures (including drawings, and material procurement and construction planning information) and 100 percent of arrangements and the three-dimensional product model completed prior to the start of lead ship construction scheduled for fiscal year 2021. Program officials stated that unmitigated, a sequestration of 2014 funds would result in up to a one year delay to the program (potentially creating a gap in sea-based nuclear deterrence), but that they will attempt to mitigate any delays to the fullest extent allowed.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: \$95,103.2 million
 Research and development: \$11,718.2 million
 Procurement: \$83,385.0 million
 Quantity: 12

Next Major Program Event: System requirements review, fiscal year 2014

Program Office Comments: According to the program office, the OR program multi-year-procurement decision has not been made at this time. The OR program intends to maximize savings from cross-class contracting with the *Virginia*-class and the United Kingdom's *Successor*-class to take advantage of benefits from economic order quantity. The OR program is currently conducting analysis on multi-year-procurement and other contracting scenarios.

Presidential Aircraft Recapitalization (PAR)

The Air Force's Presidential Aircraft Recapitalization (PAR) program is intended to recapitalize the VC-25A system and support the United States President as Head of State, Chief Executive, and Commander in Chief. PAR's principal mission is to provide the President and his staff air transportation with the same level of security and communications capability available at the White House.



Source: U.S. Air Force.

Current Status

PAR program acquisition strategy development is ongoing with milestone decision authority approval expected in the fourth quarter of fiscal year 2015. According to program officials, the program intends to acquire a large, commercial-derivative aircraft and modify it to meet desired capabilities. The program intends to seek a waiver from the requirement to conduct competitive prototyping prior to entry into engineering and manufacturing development. To ensure some form of competition, the program plans to use open architecture for future upgrades.

Since fiscal year 2012, the PAR program has conducted initial planning activities including assessing risk and systems engineering as well as analysis related to requirements, sustainment, and technology and manufacturing maturity. Risk reduction studies are planned to continue through fiscal year 2014.

The PAR system development start and contract award are expected in the fourth quarter of fiscal year 2015. Program officials reported that at present, the Air Force is still determining the number of aircraft needed to replace the current VC-25A fleet and no decision has been made on PAR fleet size. The first aircraft will be used to support research, development, test, and evaluation. Once the development is completed, the aircraft will be delivered as a fully capable aircraft to support presidential missions in fiscal year 2023. Additional deliveries will commence starting in fiscal year 2025. According to program officials, requirements are being finalized with Air Mobility Command but at the time of our review, critical technologies have not yet been identified. Officials reported that program affordability is under discussion, but no targets for the final program cost have been determined yet.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: TBD

Research and development (fiscal years 2010 through 2018): \$1,075.9 million

Procurement: TBD

Quantity: TBD

Next Major Program Event: Milestone decision authority approval of acquisition strategy, fourth quarter fiscal year 2015.

Program Office Comments: Technical comments were incorporated as appropriate.

Space Based Infrared Satellite System (SBIRS High)

The Air Force's SBIRS High satellite system is being developed to replace the Defense Support Program and perform a range of missile warning, missile defense, technical intelligence, and battlespace awareness missions. SBIRS High will consist of four satellites in geosynchronous earth orbit (GEO), two sensors on host satellites in highly elliptical orbit (HEO), two replenishment satellites and sensors, and fixed and mobile ground stations. We assessed the space segment and made observations about the ground segment.



Source: © 2007 Lockheed Martin.

Current Status

Both HEO sensors and the first two GEO satellites have been launched. One of two replenishment sensors was delivered to the host this year for integration, and the third and fourth satellites are currently in production. In October 2013, the first GEO satellite was accepted as operational, with previously identified issues resolved. This means that the data returned from the satellite is reliable. The second satellite was accepted for operations in November 2013. Each GEO satellite carries a scanning sensor and a staring sensor, which provide different data to meet program missions. The program launched the first satellite without event recovery software intended to re-establish ground control of the satellite in the event of an unforeseen failure, so that other software issues could be addressed. Given successful recovery software testing on the second GEO satellite, the Air Force plans to upload the software to the first satellite in the fourth quarter of 2014.

The Block 10 software ground system increment is expected to be delivered in March 2016, and is intended to facilitate processing of integrated data from the Defense Support Program satellites, HEO sensors and GEO satellites now on-orbit. According to the program, this software delivery will also provide the capability for fully-tuned starrer sensor data, which means that the data returned from the satellites will be cleared of background noise, such as irrelevant light sources. This capability was previously planned for inclusion in a subsequent Block 20 software delivery which is expected to achieve certification in June 2018. The program plans to fully meet operational requirements in 2019 once it has established the full on-orbit constellation of HEO sensors, four GEO satellites, completion of Blocks 10 and 20, and delivery of its mobile ground assets.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

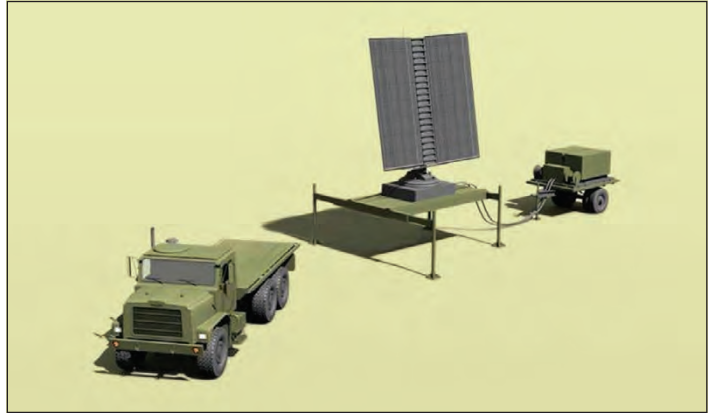
Total Program: \$18,886.4 million
 Research & development: \$11,805.5 million
 Procurement: \$6,817.2 million
 Quantity: 6

Next Major Program Event: Third GEO satellite available for delivery December 2015

Program Office Comments: In commenting on a draft of this assessment, program officials noted that the first and second satellites are operationally accepted by US Strategic Command. The third is expected early, but will need to be stored. The ground system, and fourth sensor and satellite are on-track. The fifth and sixth satellite production contract is expected fiscal year 2014.

Three-Dimensional Expeditionary Long-Range Radar (3DELRR)

The Air Force's 3DELRR is being developed as a long-range, ground-based sensor for detecting, identifying, tracking, and reporting aircraft and missiles for the Joint Forces Air Component Commander. It is intended to provide real-time data and support a range of expeditionary operations in all types of weather and terrain. It is being acquired to replace the Air Force's AN/TPS-75 radar systems.



Source: U.S. Air Force.

Current Status

The 3DELRR program entered technology development in May 2009, and these efforts included capability demonstrations of three competing prototypes. The program is scheduled to enter system development in June 2014 after it completes the source selection process for its development and initial production contract. The acquisition strategy for the program has changed in the last year. The program previously planned to award the system development and low-rate initial production contract using full and open competition. However, when the Air Force released the request for proposals for this contract in November 2013, the program limited the competition to the three contractors that had developed full-scale prototypes and completed a preliminary design review—Lockheed Martin, Northrop Grumman, and Raytheon. According to program officials, including other contractors would require more development funding to reach maturity and these costs would not likely be recouped through full and open competition. However, the program plans to take other steps, such as obtaining data rights, to maintain the ability to introduce competition for subsystems and upgrades later. The maximum total ceiling price for the planned contract is \$534 million, which includes an option for low-rate initial production.

The 3DELRR program will enter system development with its critical technologies nearing maturity. The program office reported that 3DELRR successfully demonstrated its eight critical technologies and its manufacturing processes in a relevant environment during its technology development efforts. According to the program office, the greatest risk to program execution is budget uncertainty.

Estimated Total Program Cost and Quantity (fiscal year 2014 dollars):

Total Program: \$1,531.4 million

Research and development: \$543.4 million

Procurement: \$988.1 million

Quantities: 35

Next Major Program Event: System development start, June 2014

Program Office Comments: The program office concurred with this assessment.

Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) System

The Navy's UCLASS system is expected to address a gap in persistent sea-based intelligence, surveillance, and reconnaissance (ISR) with precision strike capabilities. The system is made up of three key segments: an unmanned aerial vehicle, aircraft carrier modifications, and a control system. Working together, these segments will provide aircraft carriers with additional ISR as well as targeting and strike capabilities.



Source: U.S. Navy.

Current Status

In June 2013, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved the Navy's plan to invest an estimated \$3.7 billion through fiscal year 2020 to develop, produce, and field an initial UCLASS system with up to 24 air vehicles and modify up to four aircraft carriers, to support an early operational capability. The Navy plans to manage UCLASS as a technology development program, and does not plan to hold a formal review to enter system development until after an initial system is fielded in fiscal year 2020. Normally, activities like those planned by the Navy are commensurate with an acquisition program in system development and early production. Using this approach, the Navy is considering seeking approval to bypass a formal system development phase and proceed directly into production in fiscal year 2020 but no formal decision has been made. This approach raises concerns as the Navy could develop, produce, and field a system before undergoing the key oversight mechanisms and reviews that typically govern a program in system development.

In August 2013, the Navy awarded four separate limited source firm fixed-price contracts to develop designs for the air vehicle segment. In fiscal year 2014, the Navy plans to review those preliminary designs, conduct a full and open competition, and award a single contract to complete development and deliver the air vehicles. UCLASS is critically dependent on the development and fielding of the Joint Precision Approach and Landing System (JPALS), a global positioning system that guides aircraft onto an aircraft carrier. Navy officials expect UCLASS to hold a preliminary design review—including the air vehicle, carrier, and control segments—in May 2014 based on JPALS test progress. However, the Navy still considers JPALS one of its top risks for UCLASS.

Estimated Program Cost and Quantity (fiscal year 2014 dollars):

Total program: TBD

Research and development: \$3,700 million

Procurement: TBD

Quantity: TBD

Next Major Program Event: Technology development start, 2014

Program Office Comments: According to program officials, the UCLASS program continues to progress toward conducting a milestone A defense acquisition board review in accordance with the program's approved technology development strategy. A milestone B decision will be sought and appropriate documentation submitted for review. The program also provided technical comments, which were incorporated as appropriate.

Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. The comments are reprinted in appendix VII. We also received technical comments from DOD, which have been addressed in the report as appropriate.

In its comments, DOD stated that our assessment shows that the Department's commitment to acquisition excellence in the "Better Buying Power" initiatives continues to have a positive impact on the cost, schedule, and performance measures of the programs we assessed. As we note in the report, these initiatives seem to be having a positive effect at least in the near term. This is particularly true for DOD's implementation of "should-cost" reviews which many programs reported were responsible for significant savings. Our assessment also notes that there are still opportunities to find additional savings with two other acquisition reform efforts—affordability constraints and the promotion of competition before and after development start.

Our report also emphasizes that further implementation of knowledge-based best practices are fundamental to containing cost growth and ensuring timely delivery of the capabilities promised to the warfighter in the long term. These include early systems engineering reviews, mature technologies before development start, and the demonstration of mature designs through system-level prototyping.

We are sending copies of this report to appropriate congressional committees; the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; and the Director of the Office of Management and Budget. In addition, the report will be made available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions concerning this report, please contact me at (202) 512-4841. Contact points for our offices of Congressional Relations and Public Affairs may be found on the last page

of this report. Staff members making key contributions to this report are listed in appendix VIII.

A handwritten signature in black ink, appearing to read 'Michael J. Sullivan', with a stylized flourish at the end.

Michael J. Sullivan
Director, Acquisition and Sourcing Management

List of Committees

The Honorable Carl Levin
Chairman
The Honorable James M. Inhofe
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Richard J. Durbin
Chairman
The Honorable Thad Cochran
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Howard P. "Buck" McKeon
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Rodney Frelinghuysen
Chairman
The Honorable Pete Visclosky
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Scope and Methodology

Analysis of the Cost Performance of DOD's Portfolio of Major Defense Acquisition Programs

To develop our observations on the overall changes in the size, cost, and cycle time of Department of Defense's portfolio of major defense acquisition programs, we obtained and analyzed cost, quantity, and schedule data from Selected Acquisition Reports (SAR) and other information in the Defense Acquisition Management Information Retrieval (DAMIR) Purview system, referred to as DAMIR.¹ We converted all cost information to fiscal year 2014 dollars using conversion factors from the DOD Comptroller's National Defense Budget Estimates for Fiscal Year 2014 (table 5-9). Data for the total planned investment of major defense acquisition programs were obtained from DAMIR, which we aggregated for all programs using fiscal year 2014 dollars. Through discussions with DOD officials responsible for the database and confirming selected data with program offices, we determined that the SAR data and the information retrieved from DAMIR were sufficiently reliable for our purposes. In general, we refer to the 80 major defense acquisition programs with SARs dated December 2012 as DOD's 2013 or current portfolio and use a similar convention for prior year portfolios. We compared the programs that issued SARs in December 2012 with the list of programs that had issued SARs in December 2011 (2012 portfolio) to identify the programs that exited and entered the current portfolio. The Missile Defense Agency's Ballistic Missile Defense System is excluded from all analyses as the program does not have an integrated long-term baseline which prevents us from assessing the program's cost progress or comparing it to other major defense acquisition programs.

To determine the portfolio trends over the past ten years we collected data from the annual December SARs for the years 2003 (2004 portfolio) through 2012 (2013 portfolio). The 2009 portfolio is excluded because no annual SARs were released for the December 2008 submission date. We then analyzed the data to determine the number of programs in each portfolio year as well as the year-by-year totals for research and development, procurement, and other acquisition funding for each portfolio year as well as the total amount of funding invested or remaining and, in specific cases the amount due to cost growth. We also used DAMIR and SAR data to make a determination of system type for each program to determine the mix of system types in each portfolio year.

¹DAMIR Purview is an executive information system operated by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics/Acquisition Resources and Analysis.

To determine the cost and schedule changes on defense acquisition programs in the current portfolio over the past year, 5 years, and from baseline estimates, we collected data from December 2012, December 2011, and December 2007 SARs; acquisition program baselines; and program offices. For programs less than a year old, we calculated the difference between the December 2012 SAR current estimate and the first full estimate to identify the cost and schedule change over the past year. For programs less than 5 years old, we took a similar approach when calculating the cost and schedule change over the past 5 years. We retrieved data on research, development, test, and evaluation; procurement; total acquisition cost, and schedule estimates for the 80 programs in the 2013 portfolio.² In some cases, we divided four programs into two distinct elements, because DOD reports performance data on them separately. As a result some of our analysis reflects a total of 84 programs and sub-elements. We analyzed the data to determine the change in research and development, procurement, and total acquisition costs as well as schedule changes from the first full estimate, generally development start, to the current estimate in the December 2012 SAR. For the programs that did not have a development estimate, we compared the current estimate to the production estimate. Also, for the shipbuilding programs that had a planning estimate, we compared the current estimate to the planning estimate. For programs that began as non-major defense acquisition programs, the first full estimate we used as a baseline may be different than the original baseline disclosed in DOD SARs. We obtained schedule information and calculated the cycle time from program start to initial operational capability and the delay in obtaining initial operational capability. For programs in the current portfolio where schedule data for initial operational capability was not available over the past year, 5 years, and since first full estimates we used the same methodology as used when calculating cost change.

To determine whether programs experienced an increase or decreases in buying power over the past year, we obtained data on program acquisition unit cost to determine whether a program's buying power had increased or decreased. We reviewed SARs for those programs with changes in buying power over the past year to measure the extent to which changes in

²We refer to research, development, test, and evaluation costs as research and development or simply as development costs in this report. Total acquisition cost includes research and development and procurement costs as well as acquisition related operation and maintenance and system-specific military construction costs.

quantity impacted procurement cost changes. When analyzing buying power changes, we also calculated the amount of procurement cost growth attributable to quantity changes, we isolated the change in procurement quantities and the prior-year's acquisition procurement unit cost for programs over the past year. For those programs with a change in procurement quantities, we calculated the amount attributable to quantity changes as the change in quantity multiplied by the average procurement unit cost for the program a year ago. The resulting dollar amount is considered a change due solely to shifts in the number of units procured and may overestimate the amount of change expected when quantities increase and underestimate the expected change when quantities decrease as it does not account for other effects of quantity changes on procurement such as gain or loss of learning in production that could result in changes to unit cost over time or the use or absence of economic orders of material. However, these changes are accounted for as part of the change in cost not due to quantities.

To evaluate program performance against high-risk criteria discussed by DOD, the Office of Management and Budget (OMB), and GAO, we calculated how many programs had less than a 2 percent increase in total acquisition cost over the past year, less than a 10 percent increase over the past 5 years, and less than a 15 percent increase from first full estimates using data from December 2012, December 2011, and December 2007 SARs; acquisition program baselines; and program offices. For programs that began as non-major defense acquisition programs, the first full estimate we used as a baseline may be different than the original baseline contained in DOD SARs. We also compared the performance of the 2013 portfolio in each high-risk category with the performance of the 2012 and 2011 portfolios we reported on in prior years to identify any positive or negative changes. For programs with multiple sub-programs presented in the SARs we calculated the net effect of the sub-programs to reach an aggregate program result.

To discern the cost and schedule performance of the various system types represented in the current portfolio, we first determined each program's system type using DAMIR reported information on commodity type, the program's mission and description summary from the December 2012 SAR, and GAO analyst judgment. The programs were then grouped by system type and cost and schedule change was determined using the cost and schedule changes calculated for the programs in each system type. Development cost change and change in initial operating capability were then calculated for each group as elsewhere in this objective. For change

in procurement unit cost, a weighted average calculation was used based on the total procurement cost for programs in each system type.

To determine the funding already invested and the funding remaining that is needed to complete the 80 programs in the 2013 portfolio we used funding stream data obtained from DAMIR and the December 2012 SARs. We define funding invested as all funding that has been provided to the programs in fiscal years 2013 and earlier, while funding remaining is all the amounts that will be provided in the fiscal year 2014 and later. To show the amount of additional future funding needed due to cost growth from first full estimates to complete programs in the current portfolio, we compared a funding stream for each program that corresponded to its first full estimate at program start against the funding stream for the current estimate in the program's December 2012 SAR.

Analysis of Selected DOD Programs Using Knowledge-Based Criteria

To collect data from current and future major defense acquisition programs—including cost and schedule estimates, technology maturity, and planned implementation of acquisition reforms—we distributed two electronic questionnaires, one questionnaire for the 38 current programs and a slightly different questionnaire for the 18 future programs. Both of the questionnaires were sent by e-mail in an attached Microsoft Word form that respondents could return electronically. We received responses from all of the programs we assessed from August to November 2013. To ensure the reliability of the data collected through our questionnaires, we took a number of steps to reduce measurement error and non-response error. These steps included conducting three pretests for the future major defense acquisition program questionnaire and three pretests for the major defense acquisition program questionnaire prior to distribution to ensure that our questions were clear, unbiased, and consistently interpreted; reviewing responses to identify obvious errors or inconsistencies; conducting follow-up to clarify responses when needed; and verifying the accuracy of a sample of keypunched questionnaires. Our pretests covered each branch of the military to better ensure that the questionnaires could be understood by officials within each branch.

Our analysis of how well programs are adhering to a knowledge-based acquisition approach focuses on 38 major defense acquisition programs that are mostly in development or the early stages of production. To assess the knowledge attained by key decision points (system development start or detailed design contract award for shipbuilding programs, critical design review or fabrication start for shipbuilding

programs, and production start), we collected data from program offices about their knowledge at each point. In particular, we focused on the seven programs that crossed these key acquisition points in 2013 and evaluated their adherence to knowledge based practices. We also provide some insight into how much knowledge is obtained at key junctures by other programs we assessed as well. We also included observations on the knowledge that 18 future programs expect to obtain before starting development as well as how much knowledge 14 current programs expect to obtain before reaching their production start. We did not validate the data provided by the program offices, but reviewed the data and performed various checks to determine that they were reliable enough for our purposes. Where we discovered discrepancies, we clarified the data accordingly.

The 56 current and future programs included in our assessment were in various stages of the acquisition cycle, and not all of the programs provided information on knowledge obtained at each point. Programs were not included in our assessments at key decision points if relevant data were not available. For each decision point, we summarized knowledge attainment for the number of programs with data that had reached that knowledge point. Our analysis of knowledge attained at each key point includes factors that we have previously identified as being key to a knowledge-based acquisition approach, including holding early systems engineering reviews, testing an integrated prototype prior to the design review, using a reliability growth curve, planning for manufacturing, and testing a production-representative prototype prior to the making a production decision. Additional information on how we collect these data is found in the product knowledge assessment section of appendix I. See also appendix IV for a list of the practices that are associated with a knowledge-based acquisition approach.

Analysis of Acquisition Initiatives and Program Concurrency

To determine how DOD has begun to implement acquisition reforms, we obtained and analyzed the DOD 5000.02 acquisition instruction in place at the time of our review, the Weapon Systems Acquisition Reform Act of 2009, and the September 14, 2010, Under Secretary of Defense for Acquisition, Technology, and Logistics memorandum on “better buying power” as well as subsequent memorandums clarifying and implementing that guidance, including the “Better Buying Power 2.0” memorandum. In November 2013, DOD released an interim revision of its 5000.02 acquisition instruction with the intention of incorporating the policy changes mandated by the act and “Better Buying Power” memos. As our

data was collected prior to the release of this revision we did not use the new instruction as criteria for our assessments. To develop our observations, we analyzed questionnaire data received from the 38 current and 18 future major defense acquisition programs in our assessment to determine the extent to which specific acquisition reform issues have been implemented such as establishing affordability constraints, conducting “should-cost” analyses, using competition throughout the acquisition life cycle, and holding configuration steering boards.

To assess program concurrency we identified the programs—among those we included in our assessment—with production start dates. We used the questionnaire responses from those programs to identify the dates for the start and end of developmental testing, compared those dates to the timing of each program’s production decision and determined the number of months, if any, of developmental testing done after production start. We then compared the number of overlapping months to the total number of months of developmental testing for each program and calculated the percentage of developmental testing done concurrent with production.

Individual Assessments of Weapon Programs

In total, this report presents individual assessments of 56 weapon programs. A table listing these programs is found in appendix VIII. Out of these programs, 37 are captured in a two-page format discussing technology, design, and manufacturing knowledge obtained and other program issues. Thirty-four of these 37 two-page assessments are of major defense acquisition programs, most of which are in development or early production and 3 assessments are of programs that were projected to become major defense acquisition programs during or soon after our review. The remaining 19 programs are described in a one-page format that describes their current status. Those one-page assessments include 15 future major defense acquisition programs, 2 major defense acquisition program that are well into production, and 2 major defense acquisition programs that were recently restructured or curtailed. Over the past several years, DOD has revised policies governing weapon system acquisitions and changed the terminology used for major acquisition events. To make DOD’s acquisition terminology more consistent across the 56 program assessments, we standardized the terminology for key program events. For most individual programs in our assessment, “development start” refers to the initiation of an acquisition program as well as the start of engineering and manufacturing development. This generally coincides with DOD’s milestone B. A few programs in our assessment

have a separate “program start” date, which begins a pre-system development phase for program definition and risk-reduction activities. This “program start” date generally coincides with DOD’s former terminology for milestone I or DOD’s current milestone A. The “production decision” generally refers to the decision to enter the production and deployment phase, typically with low-rate initial production. The “initial capability” refers to the initial operational capability—sometimes called first unit equipped or required asset availability. For shipbuilding programs, the schedule of key program events in relation to acquisition milestones varies for each program. Our work on shipbuilding best practices has identified the detailed design contract award and the start of lead ship fabrication as the points in the acquisition process roughly equivalent to development start and design review for other programs.

For each program we assessed in a two-page format, we present cost, schedule, and quantity data at the program’s first full estimate and an estimate from the latest SAR or the program office reflecting 2013 data where they were available. The first full estimate is generally the cost estimate established at milestone B—development start; however, for a few programs that did not have such an estimate, we used the estimate at milestone C—production start—instead. For shipbuilding programs, we used their planning estimates if those estimates were available. For systems for which a first full estimate was not available, we only present the latest available estimate of cost and quantities. For the other programs assessed in a one-page format, we present the latest available estimate of cost and quantity from the program office.

For each program we assessed, all cost information is presented in fiscal year 2014 dollars. We converted cost information to fiscal year 2014 dollars using conversion factors from the DOD Comptroller’s National Defense Budget Estimates for Fiscal Year 2014 (table 5-9). We have depicted only the program’s main elements of acquisition cost—research and development and procurement. However, the total program cost also includes military construction and acquisition-related operation and maintenance costs. Because of rounding and these additional costs, in some situations, total cost may not match the exact sum of the research and development and procurement costs. The program unit costs are calculated by dividing the total program cost by the total quantities planned. In some instances, the data were not applicable, and we annotate this by using the term “not applicable (NA).” The quantities listed refer to total quantities, including both procurement and development quantities.

The schedule assessment for each program is based on acquisition cycle time, defined as the number of months between program start and the achievement of initial operational capability or an equivalent fielding date. In some instances the data were not yet available, and we annotate this by using the term “to be determined (TBD)” or “NA.”

The information presented on the “funding needed to complete” is from fiscal year 2014 through completion and, unless otherwise noted, draws on information from SARs or on data from the program office. In some instances, the data were not available, and we annotate this by the term “TBD” or “NA.” The quantities listed refer only to procurement quantities. Satellite programs, in particular, produce a large percentage of their total operational units as development quantities, which are not included in the quantity figure.

The intent of these comparisons is to provide an aggregate, or overall, picture of a program's history. These assessments represent the sum of the federal government's actions on a program, not just those of the program manager and the contractor. DOD does a number of detailed analyses of changes that attempt to link specific changes with triggering events or causes. Our analysis does not attempt to make such detailed distinctions.

In this year's assessment we also reviewed whether individual subcontracting reports from a program's prime contractor or contractors were accepted on the Electronic Subcontracting Reporting System (eSRS). We reviewed this information for 36 of the major defense acquisition programs included in our assessment using the contract information reported in their December 2012 Selected Acquisition Reports. See appendix VI for a list of the programs we reviewed. The contract numbers for each program's prime contracts were entered into the eSRS database to determine whether the individual subcontracting reports had been accepted by the government. While we did not assess the reliability of the eSRS database, we took steps to ensure that the data provided by the database was sufficiently reliable for the purpose of our analysis by interviewing defense officials with knowledge of DOD's process for eSRS and collecting data from program offices on contract reporting. The government uses individual subcontracting reports on eSRS as one method of monitoring small business participation, as the report includes goals for small business subcontracting. Not all prime contracts for major defense acquisition programs are required to submit individual subcontracting reports. For example, some contractors report small

business participation at a corporate level as opposed to a program level and this data is not captured in the individual subcontracting reports.

Product Knowledge Data on Individual Two-Page Assessments

In our past work examining weapon acquisition issues and best practices for product development, we have found that leading commercial firms pursue an acquisition approach that is anchored in knowledge, whereby high levels of product knowledge are demonstrated by critical points in the acquisition process. On the basis of this work, we have identified three key knowledge points during the acquisition cycle—system development start, critical design review, and production start—at which programs need to demonstrate critical levels of knowledge to proceed. To assess the product development knowledge of each program at these key points, we reviewed data-collection instruments and questionnaires submitted by programs; however, not every program had responses to each element of the data-collection instrument or questionnaire. We also reviewed pertinent program documentation and discussed the information presented on the data-collection instrument and questionnaire with program officials as necessary.

To assess a program's readiness to enter system development, we collected data through the data-collection instrument on critical technologies and early design reviews. To assess technology maturity, we asked program officials to apply a tool, referred to as technology readiness levels (TRL), for our analysis. The National Aeronautics and Space Administration originally developed TRLs, and the Army and Air Force science and technology research organizations use them to determine when technologies are ready to be handed off from science and technology managers to product developers. TRLs are measured on a scale from 1 to 9, beginning with paper studies of a technology's feasibility and culminating with a technology fully integrated into a completed product. See appendix V for TRL definitions. Our best-practices work has shown that a TRL 7—demonstration of a technology in a realistic environment—is the level of technology maturity that constitutes a low risk for starting a product development program.³ For shipbuilding programs, we have recommended that this level of maturity be achieved by the

³GAO, *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, [GAO/NSIAD-99-162](#) (Washington, D.C.: July 30, 1999); and *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, [GAO-01-288](#) (Washington, D.C.: Mar. 8, 2001).

contract award for detailed design.⁴ In our assessment, the technologies that have reached TRL 7, a prototype demonstrated in a realistic environment, are referred to as mature or fully mature. Those technologies that have reached TRL 6, a prototype demonstrated in a relevant environment, are referred to as approaching or nearing maturity. Satellite technologies that have achieved TRL 6 are assessed as fully mature due to the difficulty of demonstrating maturity in a realistic environment—space. In addition, we asked program officials to provide the date of the preliminary design review. We compared this date to the system development start date.

In most cases, we did not validate the program offices' selection of critical technologies or the determination of the demonstrated level of maturity. We sought to clarify the TRLs in those cases where information existed that raised concerns. If we were to conduct a detailed review, we might adjust the critical technologies assessed, their readiness levels demonstrated, or both. It was not always possible to reconstruct the technological maturity of a weapon system at key decision points after the passage of many years. Where practicable, we compared technology assessments provided by the program office to assessments conducted by officials from the Office of the Assistant Secretary of Defense for Research and Engineering.

To assess design stability, we asked program officials to provide the percentage of design drawings completed or projected for completion by the design review, the production decision, and as of our current assessment in the data-collection instrument. In most cases, we did not verify or validate the percentage of engineering drawings provided by the program office. We clarified the percentage of drawings completed in those cases where information that raised concerns existed. Completed drawings were defined as the number of drawings released or deemed releasable to manufacturing that can be considered the “build to” drawings. For shipbuilding programs, we asked program officials to provide the percentage of the three-dimensional product model that had been completed by the start of lead ship fabrication, and as of our current assessment. To gain greater insights into design stability, we also asked program officials to provide the date they planned to first integrate and test all key subsystems and components into a system-level integrated prototype. We compared this date to the date of the design review. We did

⁴GAO, *Best Practices: High Levels of Knowledge at Key Points Differentiate Commercial Shipbuilding from Navy Shipbuilding*, [GAO-09-322](#) (Washington, D.C.: May 13, 2009).

not assess whether shipbuilding programs had completed integrated prototypes.

To assess production maturity, we asked program officials to identify the number of critical manufacturing processes and, where available, to quantify the extent of statistical control achieved for those processes as a part of our data-collection instrument. In most cases, we did not verify or validate the information provided by the program office. We clarified the number of critical manufacturing processes and the percentage of statistical process control where information existed that raised concerns. We used a standard called the process capability index, a process-performance measurement that quantifies how closely a process is running to its specification limits. The index can be translated into an expected product defect rate, and we have found it to be a best practice. We also used data provided by the program offices on their manufacturing readiness levels (MRL) for process capability and control, a sub-thread tracked as part of the manufacturing readiness assessment process recommended by DOD, to determine production maturity. We assessed programs as having mature manufacturing processes if they reported an MRL 9 for that sub-thread—meaning, that manufacturing processes are stable, adequately controlled, and capable. To gain further insights into production maturity, we asked program officials whether the program planned to demonstrate critical manufacturing processes on a pilot production line before beginning low-rate production. We also asked programs on what date they planned to begin system-level developmental testing of a fully configured, production- representative prototype in its intended environment. We compared this date to the production start date. We did not assess production maturity for shipbuilding programs.

Although the knowledge points provide excellent indicators of potential risks, by themselves they do not cover all elements of risk that a program encounters during development, such as funding instability. Our detailed reviews on individual systems normally provide a more comprehensive assessment of risk elements.

We conducted this performance audit from June 2013 to March 2014, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Current and First Full Estimates for DOD's 2013 Portfolio of Major Defense Acquisition Programs

Table 8 contains the current and first full total acquisition cost estimates (in fiscal year 2013 dollars) for each program or element in the Department of Defense's (DOD) 2013 major defense acquisition program portfolio. For each program we show the percent change in total acquisition cost from the first full estimate, as well as over the past year and 5 years.

Table 8: Current Cost Estimates and First Full Estimates for DOD's 2013 Portfolio of Major Defense Acquisition Programs

Fiscal year 2014 dollars in millions

Program name	Current total acquisition cost	First full estimate total acquisition cost	Change in total acquisition cost from first full estimate (percent)	Change in total acquisition cost within the past year (percent)	Change in total acquisition cost within the past 5 years (percent)
Advanced Extremely High Frequency Satellite (AEHF)	\$14,559	\$6,700	117.3%	-0.9%	70.2%
AGM-88E Advanced Anti-Radiation Guided Missile (AGM-88E AARGM)	2,062	1,684	22.5	-0.4	15.1
AH-64E Apache New Build (AH-64E New Build)	2,119	2,492	-15.0	2.9	-15.0
AH-64E Apache Remanufacture (AH-64E Remanufacture)	12,499	7,617	64.1	12.9	50.2
AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM)	24,052	11,497	109.2	-0.9	23.3
AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)	3,793	4,202	-9.7	-7.0	-9.7
Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	3,583	8,576	-58.2	-12.9	-58.2
Airborne Warning and Control System Block 40/45 Upgrade (AWACS Blk 40/45 Upgrade)	2,865	2,936	-2.4	-2.4	-2.4
B-2 Extremely High Frequency SATCOM and Computer Increment 1 (B-2 EHF Inc1)	594	747	-20.5	-2.5	-17.5
B61 Mod 12 Life Extension Program Tailkit Assembly (B61 Mod 12 LEP TKA)	1,369	1,375	-0.5	-0.5	-0.5
C-130J Hercules Transport Aircraft (C-130J)	16,455	998	1548.6	-1.9	22.9
C-5 Reliability Enhancement and Re-engining Program (C-5 RERP)	7,661	11,469	-33.2	-1.1	-30.7
CH-47F Improved Cargo Helicopter (CH-47F)	15,000	3,386	343.0	0.3	8.7
CH-53K Heavy Lift Replacement Helicopter (CH-53K)	24,806	17,414	42.5	4.7	42.0
Chemical Demilitarization-Assembled Chemical Weapons Alternatives (Chem Demil-ACWA)	10,496	2,779	277.7	-0.7	34.5
Cooperative Engagement Capability (CEC)	5,491	3,096	77.4	-1.5	2.8
Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78)	36,008	37,415	-3.8	-0.8	10.5
DDG 1000 Zumwalt Class Destroyer (DDG 1000)	22,000	36,602	-39.9	0.2	-26.8
DDG 51 Arleigh Burke Class Guided Missile Destroyer (DDG 51)	107,831	15,974	575.0	2.3	30.5

Appendix II
Current and First Full Estimates for DOD's
2013 Portfolio of Major Defense Acquisition
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Fiscal year 2014 dollars in millions

Program name	Current total acquisition cost	First full estimate total acquisition cost	Change in total acquisition cost from first full estimate (percent)	Change in total acquisition cost within the past year (percent)	Change in total acquisition cost within the past 5 years (percent)
E-2D Advanced Hawkeye Aircraft (E-2D AHE)	19,899	15,516	28.2	-2.3	17.1
EA-18G Growler Aircraft (EA-18G)	13,681	9,440	44.9	16.1	46.5
Evolved Expendable Launch Vehicle (EELV)	63,924	18,276	249.8	78.4	78.8
Excalibur Precision 155mm Projectiles (Excalibur)	1,882	5,024	-62.5	1.0	-25.5
F/A-18E/F Super Hornet Aircraft (F/A-18E/F)	59,674	85,964	-30.6	-1.7	5.8
F-35 Joint Strike Fighter Aircraft (F-35)	332,320	224,775	47.8	-3.4	24.7
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	4,618	3,354	37.7	-1.4	22.8
Family of Medium Tactical Vehicles (FMTV)	19,010	10,987	73.0	-0.4	-15.7
Global Broadcast Service (GBS)	1,276	606	110.6	2.8	30.8
Global Positioning System III (GPS III)	4,376	4,145	5.6	1.0	5.6
Ground/Air Task Oriented Radar (G/ATOR)	2,298	1,542	49.1	-26.0	49.1
Guided Multiple Launch Rocket System/Guided Multiple Launch Rocket System Alternative Warhead (GMLRS/GMLRS AW)	6,520	1,860	250.6	2.9	10.0
H-1 Upgrades (4BW/4BN) (H-1 Upgrades)	12,935	3,814	239.1	-1.9	40.3
HC/MC-130 Recapitalization Aircraft (HC/MC-130 Recap)	13,788	8,797	56.7	2.9	56.7
Integrated Air and Missile Defense (IAMD)	5,804	5,289	9.7	-4.2	9.7
Integrated Defensive Electronic Countermeasures (IDECM)	2,582	2,290	12.7	2.8	16.4
IDECM Blocks 2/3	1,720	1,560	10.3	5.5	10.3
IDECM Block 4	862	730	18.0	-2.1	18.0
Joint Air-to-Surface Standoff Missile - JASSM and JASSM-Extended Range (JASSM)	7,223	2,438	196.3	-1.2	16.1
Joint Direct Attack Munition (JDAM)	7,448	3,596	107.1	2.9	18.2
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	2,782	7,011	-60.3	0.6	-61.9
Joint Light Tactical Vehicle (JLTV)	23,651	23,700	-0.2	-0.2	-0.2
Joint Precision Approach and Landing System Increment 1A (JPALS Inc 1A)	1,124	1,065	5.6	8.4	5.6
Joint Primary Aircraft Training System (JPATS)	5,999	3,918	53.1	-0.8	-3.8
Joint Standoff Weapon - Baseline Variant and Unitary Warhead Variant (JSOW)	5,739	8,359	-31.3	-0.6	10.7
JSOW - Baseline Variant	2,353	3,004	-21.7	-0.2	0.1
JSOW - Unitary Variant	3,386	5,354	-36.8	-0.9	19.6
Joint Tactical Networks (JTN)	2,261	1,032	119.1	3.9	2.2

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Fiscal year 2014 dollars in millions

Program name	Current total acquisition cost	First full estimate total acquisition cost	Change in total acquisition cost from first full estimate (percent)	Change in total acquisition cost within the past year (percent)	Change in total acquisition cost within the past 5 years (percent)
Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)	8,936	10,557	-15.4	2.1	171.5
KC-130J Transport Aircraft (KC-130J)	9,849	9,975	-1.3	-2.2	-1.3
KC-46 Tanker Modernization Program (KC-46)	44,519	46,090	-3.4	-2.7	-3.4
LHA 6 <i>America</i> Class Amphibious Assault Ship	10,110	3,345	202.3	-2.7	182.5
Light Utility Helicopter (LUH), UH-72A Lakota	1,891	1,904	-0.7	-9.3	-10.6
Littoral Combat Ship (LCS)—Seaframes	30,027	2,360	NA	-9.4	NA
LPD 17 <i>San Antonio</i> Class Amphibious Transport Dock (LPD 17)	19,424	12,318	57.7	-0.3	23.6
MH-60R Multi-Mission Helicopter (MH-60R)	14,358	5,822	146.6	-5.6	9.5
MH-60S Fleet Combat Support Helicopter (MH-60S)	8,727	3,690	136.5	-1.2	0.7
Mobile User Objective System (MUOS)	7,448	7,069	5.4	0.7	6.7
MQ-1C Gray Eagle Unmanned Aircraft System (MQ-1C Gray Eagle)	4,951	1,068	363.6	2.1	94.3
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	13,544	13,512	0.2	0.1	0.2
MQ-8 Fire Scout	2,811	2,751	2.2	3.1	29.0
MQ-9 Reaper Unmanned Aircraft System (MQ-9 Reaper)	12,706	2,774	358.1	-0.4	358.1
Multifunctional Information Distribution System (MIDS)	3,809	1,371	177.7	8.2	32.4
National Airspace System (NAS)	1,671	913	82.9	-1.7	-2.1
Navstar Global Positioning System (Navstar GPS)	9,695	7,578	27.9	0.0	-4.1
Navstar GPS Space & Control	8,081	6,538	23.6	-0.1	4.0
Navstar GPS User Equipment	1,614	1,040	55.2	0.8	-30.9
Navy Multiband Terminal Satellite (NMT)	1,937	2,441	-20.7	-0.5	-9.0
Next Generation Operational Control System (GPS OCX)	3,470	3,482	-0.3	-0.3	-0.3
P-8A Poseidon (P-8A)	34,336	32,640	5.2	-0.1	6.4
Paladin Integrated Management (PIM)	6,930	7,033	-1.5	-1.3	-1.5
Patriot Advanced Capability-3 (PAC-3)	13,157	5,482	140.0	1.6	23.6
Patriot/Medium Extended Air Defense System Combined Aggregate Program (Patriot/MEADS CAP)	11,745	28,029	-58.1	-1.0	-56.3
Patriot/MEADS CAP Fire Unit	3,383	20,365	-83.4	-0.5	-82.6
Patriot/MEADS CAP Missile	8,363	7,664	9.1	-1.2	12.6
Remote Minehunting System (RMS)	1,463	1,516	-3.5	-0.5	-8.8
RQ-4A/B Global Hawk Unmanned Aircraft System (RQ-4A/B Global Hawk)	9,874	5,671	74.1	-3.6	-6.5
Ship to Shore Connector (SSC)	4,053	4,158	-2.5	-2.5	-2.5

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Fiscal year 2014 dollars in millions

Program name	Current total acquisition cost	First full estimate total acquisition cost	Change in total acquisition cost from first full estimate (percent)	Change in total acquisition cost within the past year (percent)	Change in total acquisition cost within the past 5 years (percent)
Small Diameter Bomb Increment II (SDB II)	3,839	4,945	-22.4	-2.8	-22.4
Space Based Infrared System High Component (SBIRS High)	19,082	4,835	294.7	-1.0	43.3
SSN 774 <i>Virginia</i> Class Submarine (SSN 774)	84,350	63,582	32.7	-2.6	-5.0
Standard Missile-6 (SM-6)	8,943	5,995	49.2	41.9	54.7
Tactical Tomahawk RGM-109E/UGM 109E Missile (Tactical Tomahawk)	7,451	2,226	234.8	-1.5	52.1
Trident II (D-5) Sea-Launched Ballistic Missile UGM 133A (Trident II Missile)	56,419	54,405	3.7	1.1	4.4
UH-60M Black Hawk Helicopter (UH-60M Black Hawk)	24,368	13,641	78.6	-11.1	7.4
V-22 Osprey Joint Services Advanced Vertical Lift Aircraft (V-22)	60,668	42,173	43.9	1.3	0.3
Warfighter Information Network-Tactical Increment 2 (WIN-T Inc 2)	5,046	3,900	29.4	-20.9	29.4
Warfighter Information Network-Tactical Increment 3 (WIN-T Inc 3)	15,414	17,214	-10.5	17.7	-10.5
Wideband Global SATCOM (WGS)	4,154	1,255	230.8	-1.3	84.0

Source: GAO analysis of DOD data.

Notes: Data were obtained from DOD's Selected Acquisition Reports, acquisition program baselines, and, in some cases, program offices. Changes in total acquisition cost for the Littoral Combat Ship—Seafarers over the past 5 years and from its first full estimate are shown as "NA" because DOD reported an incomplete baseline and cost data for the program through 2010.

Changes in DOD's 2013 Portfolio of Major Defense Acquisition Programs over 5 Years and Since First Full Estimates

Table 9 shows the change in research and development cost, procurement cost, total acquisition cost, and average delay in delivering initial operational capability for those programs in Department of Defense's (DOD) 2013 portfolio over the last 5 years and since their first full cost and schedule estimates.

Table 9: Cost and Schedule Changes for Programs in DOD's 2013 Portfolio

Fiscal year 2014 dollars

	5 year comparison (2008 to 2013)	Since first full estimate (Baseline to 2013)
Change in total research and development cost	\$32 billion 12%	\$98 billion 51%
Change in total procurement cost	\$170 billion 16%	\$348 billion 40%
Change in total other acquisition costs ^a	\$4 billion 50%	\$2 billion 18%
Change in total acquisition cost	\$207 billion 16%	\$448 billion 42%
Average delay in delivering initial capabilities	12 months 14%	28 months 36%

Source: GAO analysis of DOD data.

Notes: Data were obtained from DOD's SARs and acquisition program baselines. In a few cases data were obtained directly from program offices. Some numbers may not sum due to rounding.

^aIn addition to research and development and procurement costs, total acquisition cost includes acquisition-related operation and maintenance and system-specific military construction costs.

Knowledge-Based Acquisition Practices

GAO’s prior work on best product-development practices found that successful programs take steps to gather knowledge that confirms that their technologies are mature, their designs stable, and their production processes are in control. Successful product developers ensure a high level of knowledge is achieved at key junctures in development. We characterize these junctures as knowledge points. The Related GAO Products section of this report includes references to the body of work that helped us identify these practices and apply them as criteria in weapon system reviews. The following table summarizes these knowledge points and associated key practices.

Table 10: Best Practices for Knowledge-based Acquisitions

Knowledge Point 1: Technologies, time, funding, and other resources match customer needs. Decision to invest in product development
Demonstrate technologies to a high readiness level—Technology Readiness Level 7—to ensure technologies will work in an operational environment ^a
Ensure that requirements for product increment are informed by preliminary design review using systems engineering process (such as prototyping of preliminary design)
Establish cost and schedule estimates for product on the basis of knowledge from preliminary design using systems engineering tools (such as prototyping of preliminary design)
Constrain development phase (5 to 6 years or less) for incremental development
Ensure development phase fully funded (programmed in anticipation of milestone)
Align program manager tenure to complete development phase
Contract strategy that separates system integration and system demonstration activities
Conduct independent cost estimate
Conduct independent program assessment
Conduct major milestone decision review for development start
Knowledge Point 2: Design is stable and performs as expected. Decision to start building and testing production-representative prototypes
Complete system critical design review
Complete 90 percent of engineering design drawing packages
Complete subsystem and system design reviews
Demonstrate with system-level integrated prototype that design meets requirements
Complete the failure modes and effects analysis
Identify key system characteristics
Identify critical manufacturing processes
Establish reliability targets and growth plan on the basis of demonstrated reliability rates of components and subsystems

(Continued From Previous Page)

Conduct independent cost estimate

Conduct independent program assessment

Conduct major milestone decision review to enter system demonstration

Knowledge Point 3: Production meets cost, schedule, and quality targets. Decision to produce first units for customer

Demonstrate manufacturing processes

Build and test production-representative prototypes to demonstrate product in intended environment

Test production-representative prototypes to achieve reliability goal

Collect statistical process control data

Demonstrate that critical processes are capable and in statistical control

Conduct independent cost estimate

Conduct independent program assessment

Conduct major milestone decision review to begin production

Source: GAO.

Note: DOD considers Technology Readiness Level 6, demonstrations in a relevant environment, to be appropriate for programs entering system development; therefore we have analyzed programs against this measure as well.

Technology Readiness Levels

Technology readiness level	Description	Hardware/software	Demonstration environment
1. Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties	None (paper studies and analysis)	None
2. Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.	None (paper studies and analysis)	None
3. Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Analytical studies and demonstration of nonscale individual components (pieces of subsystem)	Lab
4. Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.	Low-fidelity breadboard. Integration of nonscale components to show pieces will work together. Not fully functional or form or fit but representative of technically feasible approach suitable for flight articles.	Lab
5. Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	High-fidelity breadboard. Functionally equivalent but not necessarily form and/or fit (size weight, materials, etc). Should be approaching appropriate scale. May include integration of several components with reasonably realistic support elements/subsystems to demonstrate functionality.	Lab demonstrating functionality but not form and fit. May include flight demonstrating breadboard in surrogate aircraft. Technology ready for detailed design studies.

Appendix V
Technology Readiness Levels

(Continued From Previous Page)

Technology readiness level	Description	Hardware/software	Demonstration environment	
6.	System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated realistic environment.	Prototype. Should be very close to form, fit and function. Probably includes the integration of many new components and realistic supporting elements/subsystems if needed to demonstrate full functionality of the subsystem.	High-fidelity lab demonstration or limited/restricted flight demonstration for a relevant environment. Integration of technology is well defined.
7.	System prototype demonstration in a realistic environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in a realistic environment, such as in an aircraft, vehicle or space. Examples include testing the prototype in a test bed aircraft.	Prototype. Should be form, fit and function integrated with other key supporting elements/subsystems to demonstrate full functionality of subsystem.	Flight demonstration in representative realistic environment such as flying test bed or demonstrator aircraft. Technology is well substantiated with test data.
8.	Actual system completed and "flight qualified" through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	Flight-qualified hardware	Developmental Test and Evaluation (DT&E) in the actual system application.
9.	Actual system "flight proven" through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.	Actual system in final form	Operational Test and Evaluation (OT&E) in operational mission conditions.

Source: GAO and its analysis of National Aeronautics and Space Administration data.

Major Defense Acquisition Programs' Individual Subcontracting Reports in the Electronic Subcontracting Reporting System

Table 11 contains the numbers of individual subcontracting reports from the prime contractor for the programs we assessed that were accepted on the Electronic Subcontracting Reporting System (eSRS). We reviewed this information for the 36 major defense acquisition programs included in our individual program assessments using the prime contracts reported in available Selected Acquisition Reports. The government uses individual subcontracting reports on eSRS as one method of monitoring small business participation, as the report includes goals for small business subcontracting. There are multiple reasons why a program may not have an accepted subcontracting report in eSRS. For example, some programs may have pending or rejected reports within the system as all reports are reviewed prior to acceptance. Not all prime contracts for major defense acquisition programs are required to submit individual subcontracting reports. Instead, some contractors report small business participation at a corporate level as opposed to the program level and this data is not captured in the individual subcontracting reports.¹ Specifically, the F-35 program provided questionnaire data indicating that for the five contracts listed in the December 2012 SAR all report at the comprehensive, contractor level. Similarly for the three contracts listed by JLTV program officials, questionnaire data shows that one of them reports on small business participation at the corporate level with no participation information specific to the JLTV program. Finally, although a program may be required to submit a report it may not yet have done so for the period we reviewed.

¹Twelve large defense contractors are participants under the Test Program for Negotiation of Comprehensive Small Business Subcontracting Plans created by the National Defense Authorization Act for Fiscal Years 1990 and 1991, Pub. L. No. 101-189, § 834 (1989) and have each established a comprehensive subcontracting plan on a corporate, division or plant-wide basis under which a single summary subcontract report is submitted semi-annually for all covered DOD contracts. The test program has been extended by Congress several times with the current three year extension made by Pub. L. No. 112-81, § 866 (2011) to end on December 31, 2014. Participation in the test program is on a voluntary basis such that the 12 participants may have contracts where they are reporting on an individual basis as well as contracts where they are reporting on a comprehensive basis.

Appendix VI
Major Defense Acquisition Programs'
Individual Subcontracting Reports in the
Electronic Subcontracting Reporting System

Table 11: Major Defense Acquisition Programs' Individual Subcontracting Reports in the Electronic Subcontracting Reporting System

Program name	Number of contracts listed in the December 2012 SAR	Contracts with an accepted individual subcontracting report (as of January 2014)
AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)	2	0
Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	1	0
CH-53K Heavy Lift Replacement Helicopter (CH-53K)	1	0
<i>Gerald R. Ford</i> Class Nuclear Aircraft Carrier (CVN 78)	6	3
DDG 1000 <i>Zumwalt</i> Class Destroyer (DDG 1000)	4	3
DDG 51 <i>Arleigh Burke</i> Class Guided Missile Destroyer (DDG 51)	4	3
Evolved Expendable Launch Vehicle (EELV)	10	4
Excalibur Precision 155mm Projectiles (Excalibur)	2	0
F-22 Increment 3.2B	2	0
F-35 Lightning II (F-35)	6	0
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	2	0
Global Positioning System III (GPS III)	1	0
Ground/Air Task Oriented Radar (G/ATOR)	1	0
Integrated Air and Missile Defense (IAMD)	3	1
Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER)	3	0
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	1	0
Joint Light Tactical Vehicle (JLTV)	3	2
Joint Precision Approach and Landing System Increment 1A (JPALS Inc 1A)	1	0
Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)	1	0
KC-46 Tanker Modernization Program (KC-46)	1	1
LHA 6 <i>America</i> Class Amphibious Assault Ship (LHA 6)	2	2
Littoral Combat Ship (LCS)—Seaframes	3	2
MQ-1C Gray Eagle Unmanned Aircraft System (MQ-1C Gray Eagle)	6	5
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	1	0
MQ-8 Fire Scout	1	1
MQ-9 Reaper Unmanned Aircraft System (MQ-9 Reaper)	2	0
Mobile User Objective System (MUOS)	1	0
Next Generation Operational Control System (GPS OCX)	1	0
P-8A Poseidon (P-8A)	2	1
Paladin Integrated Management (PIM)	1	1
RQ-4A/B Global Hawk Unmanned Aircraft System (RQ-4A/B Global Hawk)	5	2
Ship to Shore Connector (SSC)	1	1

Appendix VI
Major Defense Acquisition Programs'
Individual Subcontracting Reports in the
Electronic Subcontracting Reporting System

(Continued From Previous Page)

Program name	Number of contracts listed in the December 2012 SAR	Contracts with an accepted individual subcontracting report (as of January 2014)
Small Diameter Bomb Increment II (SDB II)	1	0
Space Based Infrared System High Component (SBIRS High)	3	0
Warfighter Information Network-Tactical Increment 2 (WIN-T Inc 2)	1	0
Warfighter Information Network-Tactical Increment 3 (WIN-T Inc 3)	1	0
Total	87	32

Source: GAO analysis of data from DOD and eSRS.

Comments from the Department of Defense



ACQUISITION,
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OFFICE OF THE UNDER SECRETARY OF DEFENSE

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WASHINGTON, DC 20301-3000

21 MAR 2014

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G St NW
Washington, DC 20548

Dear Mr. Sullivan,

This is the Department of Defense response to the GAO Draft Report, GAO-14-340SP, "Defense Acquisitions: Assessments of Selected Weapon Programs" dated March 2014 (GAO Code 121144).

The Department is pleased that this year's Draft Report, the 12th annual assessment on the performance of DoD's major acquisition programs, is the most encouraging to date. GAO results indicate that the Department's commitment to acquisition excellence in the Better Buying Power initiatives continue to have a positive impact on cost, schedule, and performance measures of our programs.

The Under Secretary of Defense for Acquisition, Technology, and Logistics will again publish a comprehensive report on the acquisition system in 2014. The 2nd annual report will be a data driven analysis that provides transparent and objective performance measures of our major acquisition programs and contracts. The fiscal environment remains challenging and continues to put downward pressure on investment funding. Continued improvement of the acquisition system will require a more clear understanding of how decisions throughout the process influence performance.

The Department appreciates the opportunity to comment on the Draft Report. My point of contact for this effort is Mr. Joe Beauregard, 703-697-8046.

Sincerely,

Nancy L. Spruill
Director
Acquisition Resources & Analysis

GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

Principal contributors to this report were J. Kristopher Keener, Assistant Director; Matthew T. Drerup; Jonathan Mulcare; Danny Owens; Charlie Shivers; and Wendy Smythe. Other key contributors included Peter W. Anderson, Cheryl Andrew, David B. Best, Laurier R. Fish, Arthur Gallegos, William R. Graveline, Kristine R. Hassinger, Julia Kennon, Jill N. Lacey, Travis J. Masters, Jean L. McSween, Sean Merrill, LaTonya Miller, Diana L. Moldafsky, John Oppenheim, Kenneth E. Patton, Ronald E. Schwenn, and Roxanna T. Sun, Bruce H. Thomas, and Alyssa Weir.

The following were responsible for individual programs:

Program name	Primary staff
Current programs	
AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)	Jennifer A. Dougherty, Christopher D. Zbrozek
Air and Missile Defense Radar (AMDR)	George A. Bustamante, C. James Madar, Ioan T. Ifrim
Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	Aryn C. Ehlow, Nathan A. Tranquilli, Paul G. Williams
CH-53K Heavy Lift Replacement (CH-53K)	Robert K. Miller, Marvin E. Bonner
<i>Gerald R. Ford</i> Class Nuclear Aircraft Carrier (CVN 78)	Burns C. Eckert, Jenny Shinn
DDG 1000 <i>Zumwalt</i> Class Destroyer (DDG 1000)	Patrick M. Breiding, Angie Nichols-Friedman
DDG 51 <i>Arleigh Burke</i> Class Guided Missile Destroyer (DDG 51)	Greg Campbell, Ioan T. Ifrim
Evolved Expendable Launch Vehicle (EELV)	Desirée E. Cunningham, Maria A. Durant
Excalibur Precision 155mm Projectiles (Excalibur)	Ryan Stott, Carrie W. Rogers
F-22 Increment 3.2B	Robert P. Bullock, Christopher D. Zbrozek, Sean C. Seales
F-35 Lightning II (F-35)	Abby C. Volk, Marvin E. Bonner
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	Scott M. Purdy, Alexandra Dew Silva
Global Positioning System III (GPS III)	Laura T. Holliday, Erin R. Cohen
Ground/Air Task Oriented Radar (G/ATOR)	Bonita J. P. Oden, Jonathan Mulcare
Integrated Air and Missile Defense (IAMD)	John M. Ortiz, Carol T. Mebane
Joint Air-to-Surface Standoff Missile Extended Range (JASSM-ER)	Brian A. Tittle, John W. Crawford

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GAO Contact and Staff Acknowledgments

(Continued From Previous Page)

Program name	Primary staff
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	Maria A. Durant, John M. Ortiz
Joint Light Tactical Vehicle (JLTV)	Dayna L. Foster, Andrea M. Bivens
Joint Precision Approach and Landing System Increment 1A (JPALS Inc 1A)	Stephen V. Marchesani, Jared A. Sippel
Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)	Nathan A. Tranquilli, Aryn C. Ehlow, Paul G. Williams
KC-46 Tanker Modernization Program (KC-46)	Jeffrey L. Hartnett, Katheryn S. Hubbell
LHA 6 <i>America</i> Class Amphibious Assault Ship (LHA 6)	Christopher E. Kunitz, Jenny Chow
Littoral Combat Ship (LCS)—Mission Packages	Laurier R. Fish, Greg Campbell
Littoral Combat Ship (LCS)—Seaframes	Amber N. Keyser, Christopher R. Durbin
Mobile User Objective System (MUOS)	Richard Y. Horiuchi, Desirée E. Cunningham
MQ-1C Unmanned Aircraft System (MQ-1C Gray Eagle)	Deanna Laufer, James S. Kim
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	Tom Twambly, Candice N. Wright, Amanda Parker
MQ-8 Fire Scout	Leigh Ann Haydon, Deanna Laufer
MQ-9 Unmanned Aircraft System Reaper (MQ-9 Reaper)	Megan L. Porter, Laura Jezewski
Next Generation Operational Control System (GPS OCX)	Erin R. Cohen, Jeffrey M. Sanders
P-8A Poseidon (P-8A)	Jocelyn C. Yin, Heather B. Miller
Paladin Integrated Management (PIM)	William C. Allbritton, Marcus C. Ferguson
RQ-4A/B Global Hawk Unmanned Aircraft System (RQ-4A/B Global Hawk)	Laura M. Jezewski, Megan L. Porter
Ship to Shore Connector (SSC)	Matthew Shaffer, Beth Reed Fritts
Small Diameter Bomb Increment II (SDB II)	John W. Crawford, Brian A. Tittle
Space Based Infrared System High Component (SBIRS High)	Claire A. Buck, Maricela Cherveney
Warfighter Information Network-Tactical Increment 2 (WIN-T Inc 2)	James P. Tallon, Andrea Yohe
Warfighter Information Network-Tactical Increment 3 (WIN-T Inc 3)	James P. Tallon, Andrea Yohe
Future Programs	
Amphibious Combat Vehicle (ACV)	MacKenzie H. Cooper, Bonita J. P. Oden
Armored Multi-Purpose Vehicle (AMPV)	Andrea M. Bivens, Dayna L. Foster
B-2 Defensive Management System (DMS) Modernization	Don M. Springman, Matthew B. Lea
Combat Rescue Helicopter (CRH)	J. Andrew Walker, Robert K. Miller
Common Infrared Countermeasures (CIRCM)	Danny G. Owens, Wendy P. Smythe
Enhanced Polar System (EPS)	Bradley L. Terry
F-15 Eagle Passive/Active Warning and Survivability System (F-15 EPAWSS)	Wendell K. Hudson, LeAnna M. Parkey
Ground Combat Vehicle (GCV)	Marcus C. Ferguson, William C. Allbritton
Indirect Fire Protection Capability, Increment 2 (IFPC Inc 2)	Helena Brink, Carol T. Mebane
Joint Air-to-Ground Missile (JAGM)	Wendy P. Smythe, Ryan Stott

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GAO Contact and Staff Acknowledgments

(Continued From Previous Page)

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Next Generation Jammer (NGJ)	Teakoe S. Coleman, Laura T. Holliday
Ohio Class Replacement (OR)	C. James Madar, Amber N. Keyser
Presidential Aircraft Recapitalization Program (PAR)	LeAnna M. Parkey, Brian Smith
Presidential Helicopter (VXX)	Bonita J. P. Oden, Jerry W. Clark
Space Fence	Laura D. Hook, Jeffrey M. Sanders
Three-Dimensional Expeditionary Long-Range Radar (3DELRR)	Claire Li, Janet L. McKelvey
Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) System	Julie C. Hadley, Sean D. Merrill

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